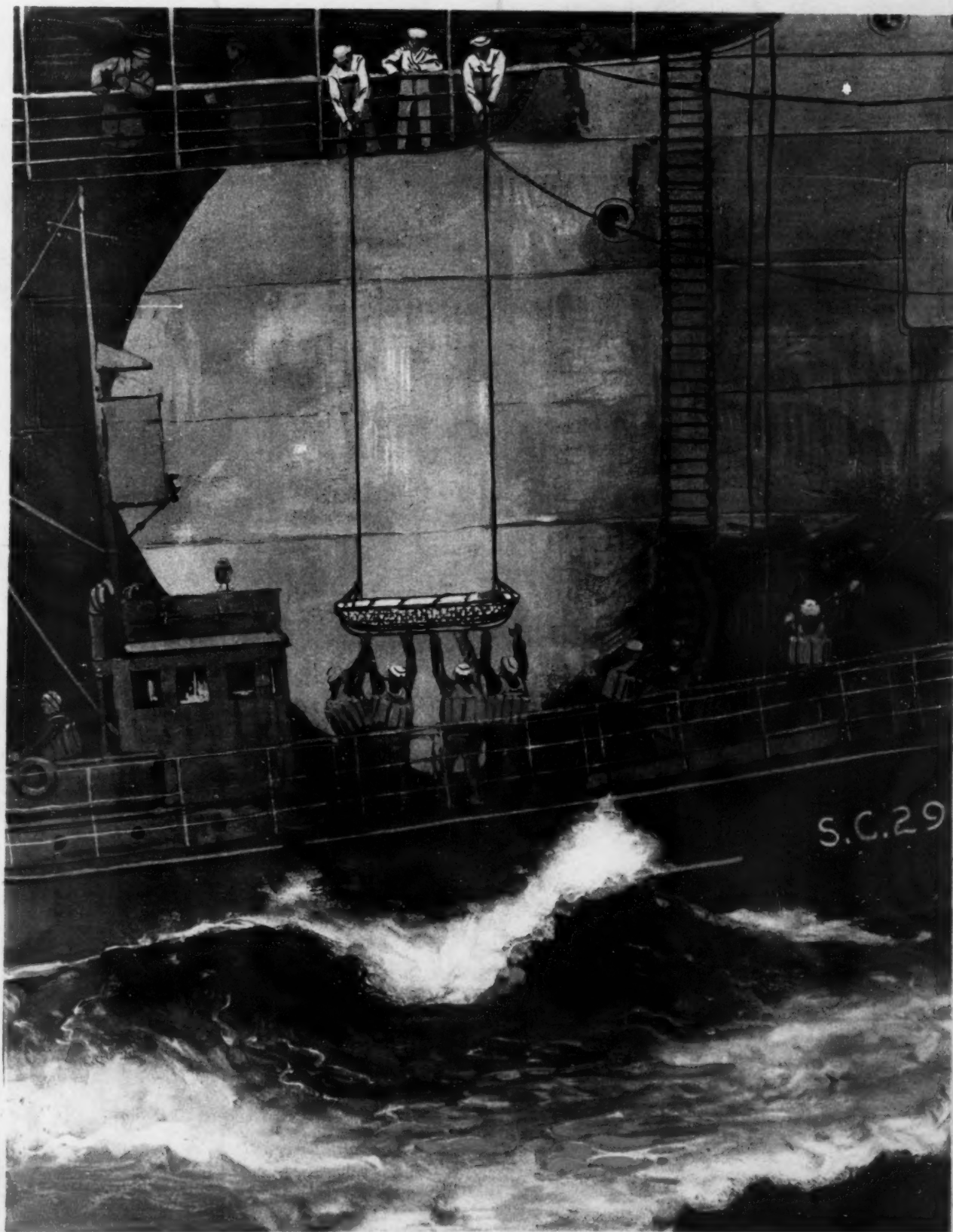


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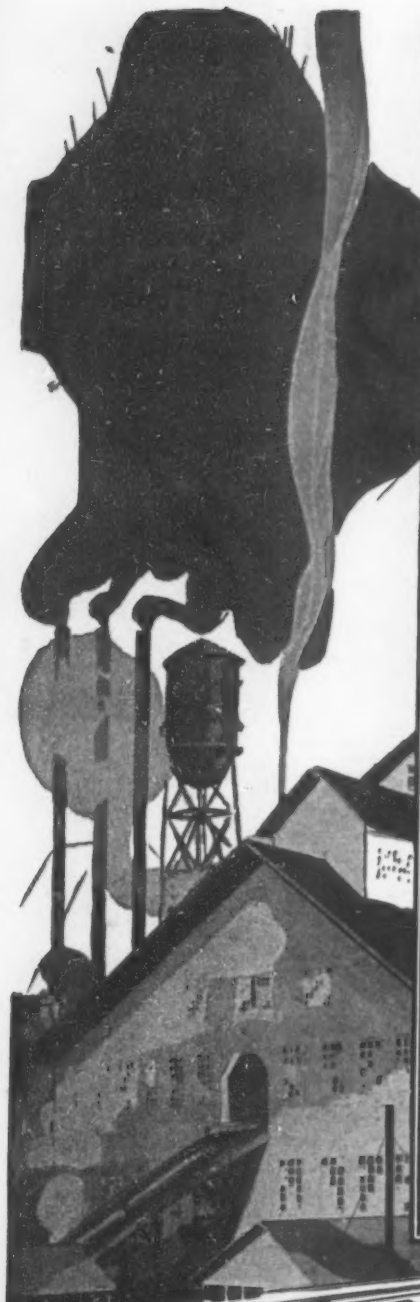


TAKING OFF THE SERIOUSLY WOUNDED IN LITTERS FROM THE STRANDED "NORTHERN PACIFIC"

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No Longer, "*Just Lumber*"

THE Long-Bell Lumber Company, the largest distributor of Southern Pine in the United States, announces that hereafter the product from its twelve great saw mills will be marked with this design

Long-Bell

This progressive age demands named goods. Heretofore lumber has not been considered adaptable to trademarking, but this company believes that the public is as much entitled to know the identity of the manufacturer of the lumber it uses, as the food it eats or the clothing it wears.

It is no longer necessary to ask for "just lumber." Whether your requirements be large or small you may specify LONG-BELL brand with the same assurance and satisfaction that accompanies the purchase of any commodity that bears the maker's guarantee in the shape of a trademark.

Ask your dealer for Long-Bell brand lumber.

The Long-Bell Lumber Co.

R. A. Long Bldg.,

Kansas City, Mo.

Manufacturer of Southern Pine, hardwood, oak flooring, and creosoted lumber, ties, posts, poles, piling and wood blocks.





Reproduced from an actual photograph of a Republic 3 1/2-ton truck

SOME PITTSBURGH USERS OF REPUBLIC TRUCKS

Riter-Conley Mfg. Co.
Carnegie Steel Co.
Dauler, Close Furniture Co.
Equitable Gas Co.
H. C. Frick Coke Co.,
Blanch's Transfer Co.
Gerstner Boiler Works
Pennsylvania Hide & Leather Co.
Hope Natural Gas Co.
Pittsburgh Foundry & Mch. Co.
Keystone Bronze Co.
Armour & Co.
Liberty Refining Co.
Beaver Refining Co.
Am. Sheet & Tin Plate Co.
May Lumber Co.
Baker Office Furniture Co.
Am. Fdry. & Construction Co.
Meadow Lands Coal Co.
Ziegler Lumber Co.
Geo. R. McAbee Fdr. & Oil Co.
Consolidated Ice Co.
W. E. Osborn Co.
P. & A. Telephone Co.
Homestead Steel Works
Best Company
People's Natural Gas Co.
Keller Piano Co.
Petroleum Products Co.
Consolidated Coke Co.
Marshall Bros. Elevator Co.
Columbia Steel & Shafting Co.
Pittsburgh Coal Co.
Follansbee Bros. Co.
Pittsburgh-Des Moines St'l Co.
Equitable Coke Co.
Famous Biscuit Co.
Enterprise Stamping Co.
Pittsburgh Leather & Glue Co.
Duquesne Packing Co.
Pittsburgh Melting Co.
Railway & Industrial Eng. Co.
Kelly & Jones Co.
Vanadium Alloys Steel Co.
Western Electric Co.
Bituminous Coal Corporation
Aluminum Co. of America
The Fairbanks Co.
Pittsburgh Bureau of Engin'g.
Copeland Coal Co.

What PITTSBURGH Thinks of Republic Trucks

In Pittsburgh, with its hills and heavy hauling, where power and stamina are absolutely essential; half of *all* the motor trucks in use are Republics.

"We found Republic Trucks so satisfactory in spite of over-loading and strenuous over-time service that we have just purchased another Republic," say Best Company, manufacturers of pipes, valves, etc.

"Because of the demonstrated efficiency of the first Republic we purchased, we are now using a fleet including 1 1/4, 2, 3 1/2 and 5 ton, all Republics," say W. E. Osborn Co., large wholesale produce dealers.

"In spite of the severity of service in the oil and gas fields and over difficult country roads our Republic Trucks have been absolutely trouble-proof," say People's Natural Gas Company.

"Even the additional abuse of war-time driving has had no apparent effect on the Republic Trucks which we have had in operation for three years. They continue to give the most satisfactory service," say Ziegler Lumber Company.

Other examples of Republic quality and dependable service could be given without limit. Each of

the owners listed in this advertisement and hundreds of others have learned the efficiency and economy of hauling with Republic Trucks. That is why there are as many Republic Trucks in operation in Pittsburgh as there are of all other makes combined.

In every city, in town and country — wherever motor trucks are used — Republic Trucks will be found, in constantly increasing numbers, performing hauling tasks of the most exacting kind.

Republic Trucks are designed and produced by specialists who know the severest conditions met by trucks in any kind of hauling anywhere and provide ample strength and power to meet them.

More than 1300 Republic Service Stations, distributed all over the United States, insure prompt reliable service to Republic Truck users everywhere.

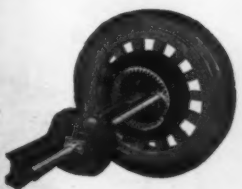
There's a Republic Truck to exactly fit the needs of your business. See the Republic dealer and let him help you select the model which will best meet your requirements.

REPUBLIC MOTOR TRUCK CO., INC.
Alma, Michigan

Republic Special, with body . . . \$1295
Model 10—1 Ton, with Express body . . . 1535
Model 11—1 1/2 Ton, chassis . . . 1885

Model 12—2 Ton, chassis . . . \$2275
Model T—3 1/2 Ton, chassis . . . 3450
Model V—5 Ton, chassis . . . 4750

All prices F. O. B. Alma, Michigan



The Torbensen Internal Gear Drive, used in all Republic Trucks, delivers 92% of the motor power to the wheels. We know of no other type of drive that delivers as much. The entire load is carried on a separate I-beam axle. The driving mechanism has nothing to do but drive the truck.

REPUBLIC

Internal Gear Drive

MOTOR TRUCKS

Built by the Largest Manufacturers of Motor Trucks in the World

Westinghouse

ELECTRIC MOTORS AND CONTROLLERS

Raising the Skyline

Story on story the steel framework of the office building lifts its lattice against the sky.

Beam after beam, girder after girder, slips into place. Swiftly the skeleton takes form and becomes a many windowed mass of steel, stone and concrete.

But the mere building is not enough. Ready to give elbow room to an army of 15,000 workers, it must include means to carry them swiftly and safely to their offices. Its twentieth floor must be as easily available as its third. Reaching the street must be a matter of but moments, and little trouble for workers on any floor.

Yet few realize how necessary is the machinery of transportation that fills and

empties the many floors of the modern office building.

Without quick, sure, perfectly controlled elevators, no sane architect would design a building of forty stories.

Without electricity, which alone meets all the power, speed and control requirements of the elevator, there would be no Woolworth Building, no Equitable Building, no Metropolitan Life.

Without electricity, New York's skyline would be low and level, and the whole thirteen miles of Manhattan Island's length would be needed to house its office workers.

Truly, the electric motor has been as vital as steel in raising the skyline to where it stands today.

Here, as in every other place of business, commerce and manufacture, for which dependable, flexible power is required, Westinghouse has taken an important part. Westinghouse Elevator Motors and Controllers serve today in many of America's best known buildings.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.
East Pittsburgh, Pa.

Starting the workers of great buildings on their homeward trip—carrying them up floor after floor in the morning, is an enormous task even for an electric elevator. Westinghouse Motors and Controllers render this service unflinching every working day.



SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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Submarine Range-Finding by Means of Reflected Sound Waves

AT best, submarine visibility is limited to a few hundred feet. Even with the most powerful searchlights and the most improved sighting means, deeply submerged objects can be detected only within a 200-foot range, which, obviously, is too circumscribed for practical purposes. And it is that very fact that has brought about the submersible fighting craft, which can steal up to its intended victim, discharge its torpedoes, and get away without showing much more than its thin periscope for a brief moment.

But where the eyes fail the ears can be made to serve. Early in the anti-submarine campaign the Allied countries set to work developing sound detectors for indicating the presence of U-boats. What success they met with has been and still remains a military secret, although it is positively known that most destroyers have been equipped with simple microphonic devices or "hydrophones." The German U-boats have also been equipped with electrical "ears," enabling them to hear the various ships and submarines about them. For the most part, however, these microphonic devices have served to give a broad indication of the presence of U-boats and other craft, and in no sense have they been employed to locate the exact whereabouts of the enemy.

When the United States entered the war, and when the U-boat campaign was practically at its height, several American inventors set to work on the submarine detector problem. Among them was Mr. Elias Ries, an electrical engineer of New York city, who worked out a submarine sound-detecting apparatus of the type shown in the accompanying drawings.

Mr. Ries will be recalled by the constant reader as the inventor of the system of aerial "ears" for mariners, which permits the accurate positioning of icebergs, landmarks, other ships and so on during the thickest fogs, and which was described in these columns some three years ago.

When it came to locating hidden submarines, Mr. Ries merely modified his aerial apparatus so as to make it available for use in water. The result is shown in the large drawing. His subaqueous apparatus consists of two megaphone receivers, A and B, pivoted at the ends of a horizontal arm. The latter member may be swung in almost any direction as shown in the upper right-hand

plan view. A sound projector is mounted in the center of the horizontal arm, as shown. The entire apparatus is fastened to the bow of a ship as shown in the lower right-hand sketch.

The submarine detector operates in the same general manner as the aerial apparatus of Mr. Ries. A sound is projected by the sound projector, and the reflected sound or echo is caught by the two megaphone receivers only when they are pointing toward the source of reflected sound. Thus the horizontal arm is swung about, while the two megaphone receivers are moved toward and away from each other, until the reflected sound is loudest,

illustrations it is only shown in the original and simple form. The megaphones can be tilted downward as well as toward each other, so that they can be brought to bear on any object on a different plane than the horizontal arm. The swinging of the horizontal arm and the megaphone receivers may be effected from the bow by means of a simple hand control, or mechanically or electrically from the bridge.

In actual use, the operator wears telephone receivers much after the fashion of the radio telegraphist. The horizontal arm is slowly swung from side to side, while the sound projector is operated at intervals. When a

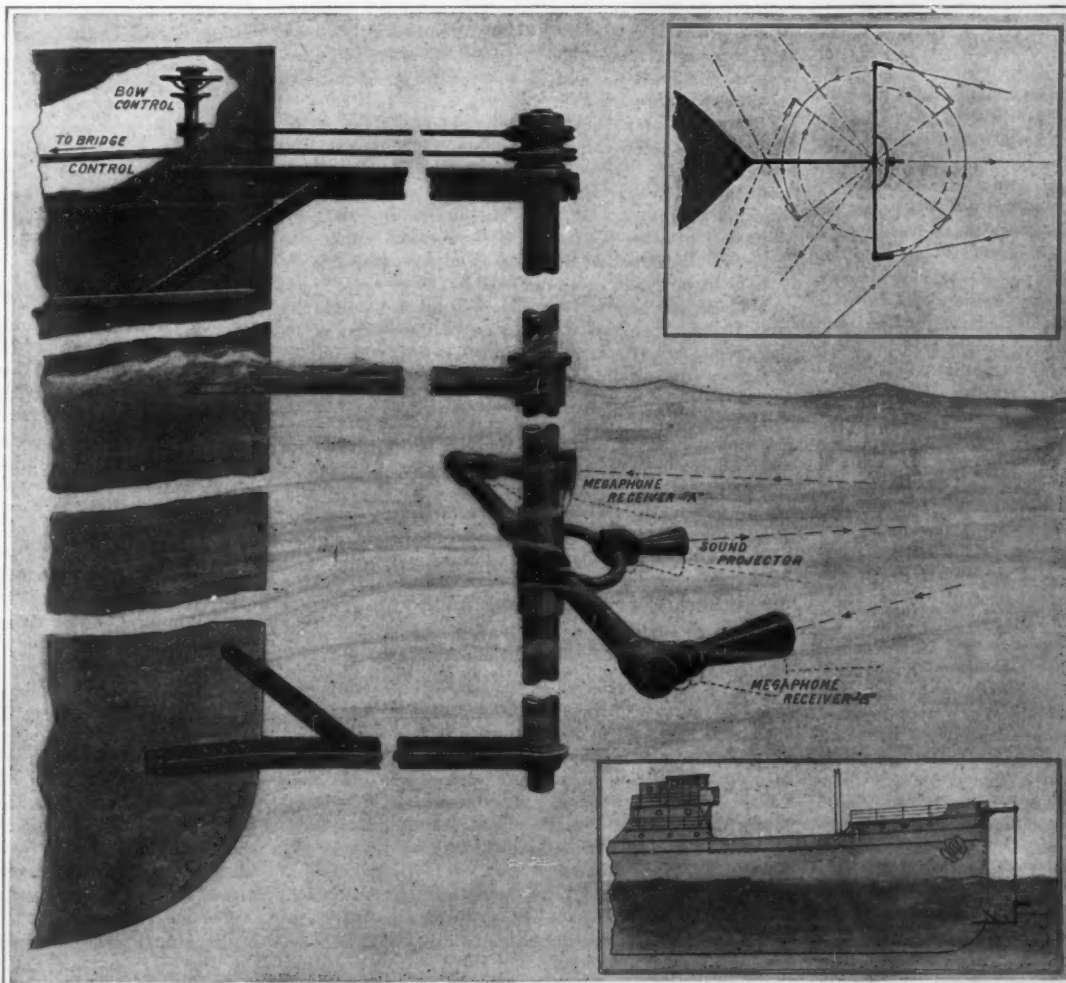
suspicious sound is caught, or when an echo is received, the operator immediately brings the horizontal arm into a definite position where the sound comes in loudest, and then focuses the megaphone receivers for still louder sound, indicating that the best focus has been obtained. By means of suitable scales it is then possible to read the range and exact position of the submerged object, whether it is a wreck, uncharted ledge, or sinister submarine. Because of the homogeneous nature of water and the use of the reflection principle, Mr. Ries claims that the range can be determined with the same accuracy as the conventional artillery range-finder.

Among the refinements of this apparatus which may be mentioned is the method of offsetting the pressure when the vessel is on the move. The inventor makes use of a simple pitot tube arrangement which compensates for the pressure on the front of the megaphone diaphragm by a counter-pressure in the forward megaphone compartment; so that no matter what the speed of the vessel may be, the pressure is always equalized and the condition is practically the same as if the vessel were standing still. If desired, the megaphones may be at-

tuned to the sound waves of the projector, so that there will be practically no interference from other sounds. By means of a double contact button which disconnects the megaphone receivers when the sound projector is operated, the operator does not hear the projected sound waves until they are redistributed by a reflecting surface. And since it is extremely difficult to draw comparisons by sound means only, Mr. Ries has introduced sensitive electrical devices which give a visual indication of the comparative values of sound waves affecting each megaphone.

For many reasons it may be best to employ sound waves

(Continued on page 82)



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By means of this device, which was originally developed for the detection of U-boats, the mariner is able to locate wrecks, uncharted rocks and other submerged objects

indicating that the apparatus is aligned with the source of the rebounding sound waves. Now if the axial line of each megaphone receiver is extended, the two lines will obviously cross at the point where the rebounding sound waves originate. And with a base line (the arm) of known length, and with the base angles (formed by the position of the megaphones as compared with the horizontal arm) also known, it becomes merely a matter of simple triangulation to determine the crossing point of the two lines, which is the apex of the isosceles triangle thus formed.

This type of submarine detector has been developed to a fine degree by Mr. Ries, and in the accompanying

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Port and Harbor Facilities

ONE of the most important papers presented at the War Emergency and Reconstruction Congress at Atlantic City in December last, was one bearing on the very serious question of the Port and Harbor Facilities of the United States. This matter is very intimately related to the question of the greater American merchant marine which is now in course of construction.

The strange national complacency with regard to the absence of an American merchant marine disappeared with the withdrawal of hundreds of thousands of tons of neutral and German shipping from our commerce, and with the insistent demand for bottoms, resulting from the enormous purchases of munitions and war supplies by Great Britain, France, Russia, and Italy. Manufacturers were hurrying shipments to the Atlantic ports, regardless of the dates of sailings of vessels and the limited storage facilities at those ports. Wharves, docks, freight yards, warehouses, etc., became choked with freight and, for miles behind the seaboard, sidings and tracks were congested with loaded freight cars.

The solution of the problem was sought in the two directions of building a large merchant fleet and of increasing the efficiency of the port and harbor facilities. Investigations by the Shipping Board showed that the dry docks were utterly inadequate to meet the needs of the ships in use; that the methods and appliances for loading and unloading cargo in the majority of the ports were inefficient; that the marine terminals were inadequate; and that there was no coordination of towage and lighterage facilities. As the result of its investigation, the Shipping Board created on May 23d, 1918, the Port and Harbor Facilities Commission.

Careful study of the various elements entering into the export and import trade of this country has convinced the Port and Harbor Facilities Commission that one of the most important factors in the upbuilding of our maritime commerce is the adoption of a zoning system, under which exports and imports will flow through those ports which are within economic transportation distance of the points of origin and destination. Knowing the point of origin of a commodity, the determination of the port through which it should be exported does not by any means depend solely upon proximity and railroad facilities. Other factors enter into the question, such as the percentage that is exported of the total of a commodity that is mined, manufactured, etc., at a given point. Statistics tell us the total amount of a commodity exported through our various ports, but we have no statistics showing the proportion of the total exports distributed by the several points of origin. Thus, we know that in 1914 Illinois produced three times the amount of agricultural implements that was produced in any other state, but it does not follow that the same proportion obtains in regard to exports. That is one of the subjects which the Commission now has under investigation. A like condition obtains in respect to the destination of imports. Statistics tell us the total amount of each commodity received annually at each of our ports, but we have no data as to the destination of these commodities. This is a matter of supreme importance, for the success of a port depends on its ability

to maintain an economic balance between its exports and its imports. Thus, a port may be the nearest point at which a vessel can unload; but if it cannot provide a return cargo, the vessel will make another port at which such cargo can be obtained. The Commission is now engaged in determining what proportion of our export trade originates at each of the important centers of production, and to what points our imports are distributed. With these statistics tabulated, the Commission will be able to establish an economic zoning system.

The congestion at the North Atlantic ports was due mainly to the fact that 75 per cent of our war industries are located east of the Alleghany Mountains and north of the Potomac; and also to the fact that the Allies being our largest purchasers, there was an unprecedented movement of freight to the Atlantic seaports.

The use of pier transit sheds as storage warehouses has been a serious handicap. The Commission recommends the construction of adequate warehouse storage facilities, inshore and adjacent to the transit sheds, as the most effective way of increasing the efficiency of the marine terminals.

It must be understood that the Shipping Board does not possess any authority to finance the improvements necessary in the various harbors of the country, and it believes that the best guarantee of the success of a port is the investment in its improvements by those who will be benefited by the resulting increase of its business. To this end, the Commission has urged the municipal officers of all seaport cities to cooperate in the appointment of Port Commissions, whose functions will consist in stimulating interest in maritime commerce in their several communities and in the territory tributary to their respective ports.

When the ships now in course of construction are completed, there will be approximately 17,300,000 dead weight tons of shipping under the American flag. That tonnage will call for a very large equipment of dry docks and marine railways—in immense undertaking in itself. Furthermore, the Commission is recommending the extensive introduction of modern, improved appliances for the loading and unloading of freight.

We can well believe that each step taken by the Port and Harbor Facilities Commission in the course of its investigation has served to impress it with the importance and magnitude of the task with which it has been entrusted.

Compared with our wealth and our vast and ever-growing commerce, our port and harbor facilities are woefully inadequate; and in our great effort to build, in a few years' time, a merchant marine which normally would call for several decades of growth, we must not forget that our port facilities are also far below requirements and that they must be enlarged, improved, and thoroughly modernized, contemporaneously with the construction of our new merchant marine.

Our Achievements in Aviation

WITH the raising of the ban of censorship, the story of America's effort in the air can at last be told in its entirety. It is a remarkable story; for it tells how the United States, in the brief space of a year and a half of war, established a gigantic aeronautical industry, built up a huge fleet of airships of all kinds, trained an army of airmen, and developed a standardized airplane engine as well as several all-American types of airplanes.

It has remained for Major-General George O. Squier, Chief Signal Officer of the Army, to give us real facts and figures concerning our aerial activities. This he did during a recent address before the American Institute of Electrical Engineers in New York City. The facts and figures given below are his.

At the outbreak of the war we had a negligible air fleet, comprising a handful of training planes and about as many trained fliers. There was no real aeronautical industry. Our aeronautical engineers and designers were so few as to be negligible. But once we entered the war, our Government immediately realized the importance of aviation. The \$10,800,000 appropriation granted in the act of May 12th, 1917, the \$31,846,000 and finally the \$640,000,000 left no doubt that we were in earnest.

As to what has been done, we first learn that 8,600 fliers have been trained in this country since the war began.

Monthly graduations at the flying schools have constantly increased. Figures prove our training fatalities to be less than those of any other country. Our students have flown more than 880,000 hours, which is the equivalent of 66,000,000 miles. The monthly average in the United States has been only one fatality for each 3,200 hours flown.

More than 16,000 Liberty engines were produced in the calendar year 1918. To November 11th, 1918, more than 14,000 Liberty engines were produced, equivalent to 5,700,000 brake horse-power.

On November 11th, 1918, there had been developed, tested and adopted by the Army four airplanes, on which production would have started this year. They were the Lepere, the De Haviland 9-A, the Martin twin-engined bomber, and the Loening two-seater fighter. The first three were equipped with the Liberty engine, while the last carried the Hispano-Suiza engine, also being turned out in quantities.

To turn out the vast number of machines shipped overseas, an industrial army of about 350 firms and corporations, employing more than 200,000 men and women, had to be mobilized. A cotton fabric had to be developed to take the place of the linen formerly used for airplane wings. Huge lumber camps had to be organized in the Northwest, in order to obtain the spruce and other lumber required.

Meanwhile the Navy erected the large Naval Aircraft Factory for building its own planes. It developed a huge flying boat, equipped with two Liberty engines, for anti-submarine, convoying, and coast-patrol work. It developed a still larger flying boat, equipped with three engines, which recently carried 51 passengers.

Many achievements were scored in the research field. Our chemists worked out a commercially practicable method of obtaining non-inflammable helium gas for balloons and airships, thus placing these lighter-than-air craft on a more equal footing with the airplane type.

All in all—and the foregoing is only the barest outline of what has been done—our record in the air has been one of the greatest surprises of the war.

Electric Waves from Ocean Tides

OBSERVATIONS which indicate that there is a subterranean electric wave analogous to the ocean tide and derived therefrom have been made at the St. Louis observatory on the Island of Jersey, and recently reported before the French Academy. The iron pipes which deliver gas and water, respectively, to the observatory, on being tested by a sensitive galvanometer showed the existence in the ground of an electro-motive force of 0.1 volt, whose variations were registered photographically through a period of ten months. In the opinion of the observer, M. Marc Dechevrens, the current is evidently affected by action of the moon, through the oceanic tides.

The voltage exhibits a maximum value twice a day and a minimum value twice a day; the two oscillations are almost equal, like those of the level of the sea.

The entire variation is accomplished in about twenty-five hours of solar time; the maxima and the minima for any given day therefore occurred 50 minutes later than upon the day before. This is precisely like the daily retardation in the passage of the moon to the meridian and like the daily retardation of the tides.

If it is really the movement of the waters which is the origin of the electric current observed we would not expect to find the maximum voltage concurring with high tides. The maximum electro-motive force may be connected with low tide, preceding it by two hours.

The maximum amount of attraction upon the water by the sun and the moon acting together takes place at the time of the equinoctial new moon. At Jersey, the highest tide which results from this action in concert is not produced until after the lapse of an interval of 40 hours and 30 minutes on the average. The greatest variation in the electro-motive force at the same period is registered as a minimum of voltage about 38 hours and 30 minutes after the rise of the new moon, or two hours before the highest tide of the year.

During the development of the tide at Jersey the sea rises during a period of 5 hours and 40 minutes but requires 6 hours and 40 minutes to fall. In the case of the electric current the intervals of time which most closely accord with those of the tide are 5 hours and 15 minutes for the diminution of the voltage and 7 hours and 18 minutes for its increase.

Electricity

A Simple Cable Connector has been in use for some time past, in Germany and other European countries. It consists merely of a flat metallic tube in which a series of notches are made with a special tool, after the two ends of the cable to be joined are properly inserted. The contact is said to be perfect, and the grip is such that the cable breaks before the connector gives way.

Wireless and Morale.—Since the armistice brought hostilities to an end it has been learned that the morale of the population of Lille was maintained by news given from a French wireless station hidden from the Germans, according to *Wireless Age*. Good news spread quickly through underground channels. The people knew that 10,000 American soldiers were arriving daily. Airplanes also dropped many leaflets, which were eagerly taken despite German efforts to prevent their distribution.

Efficiency of the Moore Light.—A contribution by Dr. M. Wolfke to the Bulletin of the Association Suisse des Electriciens refers to some tests carried out on a Moore tube installation using carbon dioxide gas. Figures for the consumption varying from 4.7 to 6.0 watts per hefner-candle are given, and it is shown that the former was apparently a minimum when the installation consumed about 2,000 watts. In the case of tubes filled with nitrogen the efficiency is much better, about 1 to 2 watts per hefner being recorded, while the Neon tube operates at less than 1 watt per hefner. It is known also that the efficiency of the CO₂ Moore tube can be materially improved by introducing a choker in the primary circuit with a view to producing a modification in the form of the wave.

British Radio-Telegraph Schemes.—It is reported that various schemes are under consideration for the development of radio-telegraphy throughout the British Empire, particularly in the Far East, the Pacific, and the West Indies. It is proposed to establish stations at Singapore, Colombo and Hong Kong that will be able to communicate with the systems about to be established in China and with those already existing in Japan. The stations to be established in the Southern and Western Pacific will come into line with the Australian and New Zealand systems. Some of the islands of the British West Indies are already connected by radio telegraphy, but it is proposed to extend and improve the system so that all the colonies in the Caribbean Sea will be in communication with each other and with London. All these systems will be state owned.

Rivetless Ships.—The Committee of Lloyd's have recently carried out a series of experiments to determine as far as can be done by means of tests and analysis, the general trustworthiness of structural connections effected by electric welding and their capacity to stand the strains to which they would be subjected in practice. The Committee had before them the report from the society's Chief Ship Surveyor on the results of these experiments, and to assist them in their deliberations a demonstration was given at the society's offices. After careful consideration, the Technical Committee decided to recommend to the General Committee for approval certain recommendations put forward by the Chief Ship Surveyor as all the conditions on which, as a tentative measure, welding might be adopted instead of riveting in the construction of vessels intended for classification in Lloyd's Register Book.

Electroplating to Balance Shells.—According to *L'Usine*, in most munition work there will be found in spite of the care of the mechanical processes, a certain number of shells that are badly balanced. It is desirable, if possible, to save such shells, and various methods of restoring the balance have been tried. For example, acids have been employed to reduce the surface at specified points, but this gives rise to irregularities and involves certain dangers in manipulation. A better method, which has been more recently employed, is to deposit a certain amount of metal at the weak point by a simple electroplating process. It is said that a deposit of 1.41 ounces is usually the limit necessary to correct a 3-inch shell, and with a current of 12 amperes the process takes three or four hours. Various devices are described for enabling different defects to be eliminated, e. g. for restoring the balance of a shell whose center of gravity is too low, or situated eccentrically from the axis.

Science

Expansion of Insulating Materials.—During the past year the Bureau of Standards has tested and heat-treated a number of synthetic insulating materials, such as "bakelite," "condensite," "formica," etc., in order to obtain information required in connection with the Bureau's spark-plug investigations. The tests show that, without exception, the substances above mentioned are unsuitable for use in delicate apparatus which may be subjected to temperatures above 60 deg. C. The thermal expansion soon vanishes, and continued treatment shows marked contraction and loss of weight of the specimen. The Bureau will publish a paper on this subject.

Branch Hydrographic Offices in War Time.—During the war the various branch Hydrographic Offices of the Navy performed a large amount of special work in addition to their routine duties of collecting and disseminating maritime information. Five of them were engaged in recruiting and enrolling; four gave instruction in navigation to Reserves and Naval Militia; others co-operated in naval intelligence work, purchase of sextants, compass inspection, cable censorship, and the "Eyes for the Navy" movement, which resulted in their obtaining, free of charge, some 2,300 marine glasses, besides numerous other instruments, as loans to the Navy.

New United States Life Tables.—In the year 1916 the U. S. Census Bureau published a collection of "life tables," based on the census of 1910 and the mortality in the three years 1909, 1910 and 1911 for the six New England states, New York, New Jersey, Indiana, Michigan and the District of Columbia. These tables were similar to those prepared by life insurance companies, except that they related to the entire population of the area covered instead of being limited to risks selected through medical examination or otherwise. The Bureau now announces that it has ready for publication a new series of similar tables exhibiting mortality conditions in 1890 and 1901 and during the decade 1901 to 1910, inclusive. In connection with certain tables there will be given commutation columns and data as to annuities and single and annual premiums at various rates of interest.

New Quarters for the Hydrographic Office.—The hydrographer of the Navy, in his last annual report, calls attention to the urgent need of new and permanent office accommodations for the Hydrographic Office. Like so many other branches of the Government, the Hydrographic Office is now domiciled in rented rooms, which are both crowded and ill-adapted to the work carried on. In this connection Admiral Schroeder revives the project of consolidating the Hydrographic Office with the Naval Observatory, i. e., a return to the arrangement that existed prior to 1866, and notably in the days when the achievements of M. F. Maury shed lustre on these two establishments of the Government. The lease of the present quarters expires in 1923, which would be a favorable time for the proposed amalgamation. The hydrographer's plan is to erect a building for his office in the Naval Observatory grounds, where ample space is available.

The National Physical Laboratory, the leading establishment in Great Britain devoted to scientific research, has grown so rapidly under stress of war requirements that it now has a staff of 532, as compared with 26 in 1902. The last annual report, although as in previous years since 1914 chiefly notable for the things that, for military reasons, it omits to mention, is an impressive record of strenuous and valuable work. New buildings are in course of construction to provide facilities for manufacturing a certain class of gages and for testing glass vessels for chemical work—both undertakings being on behalf of the Ministry of Munitions. The number of munition gages tested at the laboratory has amounted to nearly 10,000 a week. Additional large air channels have been required to meet the demands of the Air Ministry. More than 3,000 clinical thermometers have been tested per week. Three new clinical test baths have been provided, each having a capacity of 600 thermometers a day. Under the head of optics, besides routine testing on a large scale, important work has been done in testing the refractive properties of optical glass and in simplifying the calculation and design of optical systems.

Aeronautics

Airplanes for the Sportsman.—Now that the military aviator is returning to peaceful pursuits there are many who believe that he will not give up flying. Indeed, there are several aircraft constructors who are already offering inexpensive airplanes for private use. One of the offerings is in the form of a small biplane, designed "for the man who rides his ranch, and the man who loves the air," to quote the manufacturer's announcement. It is known as the "Dispatch Model" and sells for \$2,500. The factor of safety is said to be high, while the cost of upkeep is low.

Weather Forecast for Fliers.—The first aerial weather forecast to be issued in the United States was made public recently by the Weather Bureau in cooperation with the aerial mail service of the Post Office Department. It was as follows: "New York to Cleveland, cloudy, 8 P. M. Snow near Lake Erie. Winds moderate northwest to north northwest, east of the Alleghenies up to 6,500 feet and moderate south winds west of Alleghenies, shifting to west southwest at about 1,500 feet. Forecast, snow today, Monday, with increasing northeast to north winds up to about 6,000 feet, backing to strong northwest above." Since the attempted inauguration of the New York to Chicago mail service between those and intermediate cities, it is understood that the forecast is to be extended to all the territory covered by the winged postmen.

German Aircraft for Peace.—From such reports as have reached us since the signing of the armistice, it appears that the Germans are bent on making the most of their huge aeronautical establishment which was built up for military purposes. Almost immediately after the armistice was signed, the Staaken plant, located near Berlin, began converting the fighting planes on hand into commercial machines. The Germans have made it known to the entire world that they intend linking up all the European capitals with Berlin. Already, dozens of planes built entirely of aluminum have been transformed for an extensive aerial postal system. It is said that a huge machine is being built at the Staaken works for a transatlantic flight. The machine has a wing-spread of 198 feet and its multiple-engine power plant develops 3,000 horse-power.

The Race to the North Pole.—It seems that Captain Bartlett is not going to have things entirely his own way in his airplane expedition to the North Pole, for at the present moment the British are also planning for a similar undertaking. So the airplane expedition may take on the complexion of a sportsman-like air race, with the Americans represented by Captain Bartlett and the British by Salisbury Jones of the British Northern Exploration Company. Captain Bartlett contemplates going to the Far North by way of North Greenland, while Mr. Jones is going by way of Spitzbergen; which, when reduced to mathematics, means that the Americans will have some 2,000 miles to go while our British cousins will have only 900 miles of journey. Mr. Jones believes that his expedition can make the flight in about nine hours.

An American Passenger-Carrying Record.—Recently, the NC-1, a U. S. Naval seaplane, broke the world's record for passenger carrying by flying with 50 passengers at the naval air station at Rockaway, N. Y. No special modifications of the plane were made for the flight, which was intended to demonstrate the machine's lifting power. The NC-1 is the first American tri-motored seaplane. She is of the flying boat type, with wings having a spread of 126 feet. With three low-compression Liberty motors of 385 horse-power each, the huge seaplane makes a speed of about 80 miles an hour. With the 50 passengers the seaplane developed 72 miles an hour. It is not believed that this record will long endure, for there are many giant airplanes and seaplanes now ready for flight or almost ready, which will soon challenge the present record. The day of the large heavier-than-air machine has arrived, and the competition seems to have swung from the lighter and faster machines to the large weight-carrying machines. After all, the latter are the ones that have a true commercial value, which accounts for this change in effort. Caproni, the Italian exponent of huge machines, is reported to have a triplane of 2,100 horse-power, which should carry about 70 passengers, while another rapidly nearing completion, should carry 100 or more passengers.

The Voice of the Sea

Favorite Nooks on the Shores of the Atlantic and the Pacific

By LeRoy Jeffers, F.R.G.S.



The surf at the entrance to San Diego harbor

ONE of the most beautiful sections of our Atlantic coast is that of the north shore of Massachusetts. Extending from Nahant to Cape Ann and beyond to the fascinating sand dunes of Ipswich may be found a surprising variety of delicately curving beaches, rocky pine-clad points, and brown wave-swept reefs and ledges over which the sea murmurs softly in summer, and storms wildly in the great gales of a northern winter.

At Swampscott-by-the-Sea, one finds a charmingly varied coast line with bold, forbidding cliffs and wooded hills. The view from the tower of Phillips School is of surprising extent and beauty. Beyond the slender finger of Lincoln House Point is anchored a remnant of the fleet of schooners that in former days sailed to the Grand Banks, returning laden to the water's edge with cod, haddock and halibut. In the distance Egg Rock rises boldly from the ocean near the long peninsula of Nahant, while on the horizon the South Shore often looms in fanciful mirage. White sails gleaming and coastwise steamers trailing long ribbons of smoke pass in and out of Boston harbor. Across the water are the spires of Lynn, and beyond are the towers and domes of Boston. Landward the eye roams over a vast forested area of rolling hills, while the north affords a glimpse of Salem and the sea.

On the beach among the clam shells and lobster pots one may find the masters of many a long-departed vessel ready to spin their yarns of storm and shipwreck. Dorries laden with the morning's catch of fish or with men returning from the nets are constantly arriving, and on

the bay the sails of pleasure craft are flitting back and forth before the breeze. The summer visitors stroll along the beaches in the sunshine or loiter in the moonlight when the sea is calm; but none are here when the storms of winter sweep in with sudden fury from the

Sometimes twenty or more feet in height, they tumble one upon another, changing from green to frothy white and singing with ten thousand voices which the wind gathers into one, bearing it inland over the snow for miles.

Regretfully must one rely on memory to picture the surpassing grandeur of the greatest storms, for they often reach their height with the tide, too late of a winter afternoon for the camera to record. I know of no more fascinating branch of photography than surf work, for it involves the most uncertain conditions of storm and of light combined with the constant thrill of danger from wind and wave. To operate a large camera with tripod in a gale involves lively work. How rarely does the sun peer through the clouds at just the right moment, and how often does the height and composition of the next wave surpass the one which has been photographed! As a wall of foaming water comes sweeping into a rocky cove, carrying everything before it in wild confusion, one's decision must be made in an instant, for in the next moment one may find himself amid the seaweed and driftwood waist-deep in the briny sea. Often one must steal far out on treacherous, wave-washed rocks in order to look shoreward toward the spray-covered cliffs. One has not only to watch for and to capture the wave at its instant

of highest ascent, but one must also note from the corner of his eye the approach of a billow likely to engulf him. Often have I struggled against a gale that threatened to hurl me into the foaming cauldron of the sea, crouched to await a moment of sunshine at the right instant for a



The surf from the backwash at Coronado

broad Atlantic. In the southeast gales the waves come short and choppy, breaking in white-caps far out upon the sea; but the full power of the ocean comes majestically with wind and tide in the great northeast storms whose mighty waves roll in unbroken to the shore.



Where two seas meet on the Lynn breakwater



The surf at Little's Point, Swampscott

picture, only to be forced to run for life from a rear attack of which no warning had been given. Happy is he who can outdistance the wave, for the alternative is to cling desperately to the rocks while seeming tons of spray drench one in a smothering icy downpour.

What inexpressible joy is mine on sunlit mornings to wander alone along the shore, responding with all my being to the great waves, soaring mountain-high upon the rocks in radiant foam. Deep creamy froth is spread upon the water, and the air is full of the sublime music of the sea. Even in mountaineering I have found no grander manifestation of power than that of the awakened sea. The wild fury of the avalanche, expending its energy in a few brief moments as it sweeps all life from its pathway, is less impressive than is the measured attack of wave after wave rolling in from the ocean to break upon the cliffs in ever-changing forms of beauty and wonder. What exhilaration there is in watching these great upshoots of spray mounting higher and higher with the incoming tide, until they call forth one's deepest shout of admiration and one's keenest longing to share his joy with another. Sometimes the surf is heavy, attacking the rocks in solid masses, and forcing the very air to vibrate with its intensity. Again at nightfall, bleak and chill, the surf towers ghostly against the leaden sky, and the wail of the wind sends one shivering on his homeward way.

On peaceful evenings, at Ocean House rocks, the deep orange moon sparkles softly upon the velvet waters, while the red eye of Egg Rock gleams across the bay, and beyond are Boston light, the Graves, and Minot's Ledge, flashing intermittently. In northeast storms, the great green rollers break upon these rocks in magnificent avalanches of pure white foam. Unforgettable are the seascapes in which the enormous globe of the sun, sinking in a purple sky, glows with deepest vermillion and crimson, painting an indescribable pathway of brilliant, changing color across the foaming water. Surpassingly beautiful is the iridescent mirror at the pathway's ending on the sand. Each wave spreads a fairy film of creamy white and green upon its surface, and, retreating, awakens the hidden fire of a million opals.

In summer one may clamber over the rocks from Galloupe's to Little's Point in safety, peering into the ocean gardens where the dark red and brown masses of the seaweed rise and fall with the swell, and the long ribbons of the kelp wave to and fro. Crabs and fishes roam at will amid these forests, and in the tiny pools left by the tide the star fish linger. Sea gulls ride upon the waves or gather in noisy confusion upon the rocky isles. Beyond the ledges are the weather-beaten sails of the fishing schooners. Bringing sweet odors from the wild rose and the bayberry, the wind wanders along the point, nodding the thick rich sprays of the sea-loving golden-rod. Red and brown are the grasses, brown and red and gray are the wave-worn ledges. To the artist's eyes they glow with color like flower fields of rich orange and delicate pink. At low tide their sides are shaggy with seaweed and banded in white with barnacles. Beyond Little's Point is a long steep beach of beautifully rounded stones which the sea has for centuries been grinding into coarse yellow sand, singing as it rolls the pebbles up and down. Delicate sea mosses of white and purple, of green and red, are cast up by the waves which curve in stately deliberation as they break upon the shore. Farther on is the quaint old town of Marblehead. If you have not followed its narrow and winding streets, studied the curious legends upon its ancient gravestones, or watched a yacht race from the rocks of Marblehead Neck, you have joys awaiting you.

Along the wilder portions of the Swampscott coast no one is found to brave the winter storms. Glorious days are these in which the throbbing heart of the sea beats loudly, and the water lashes itself into froth which the wind gathers and rolls up the beach or carries in shreds high over



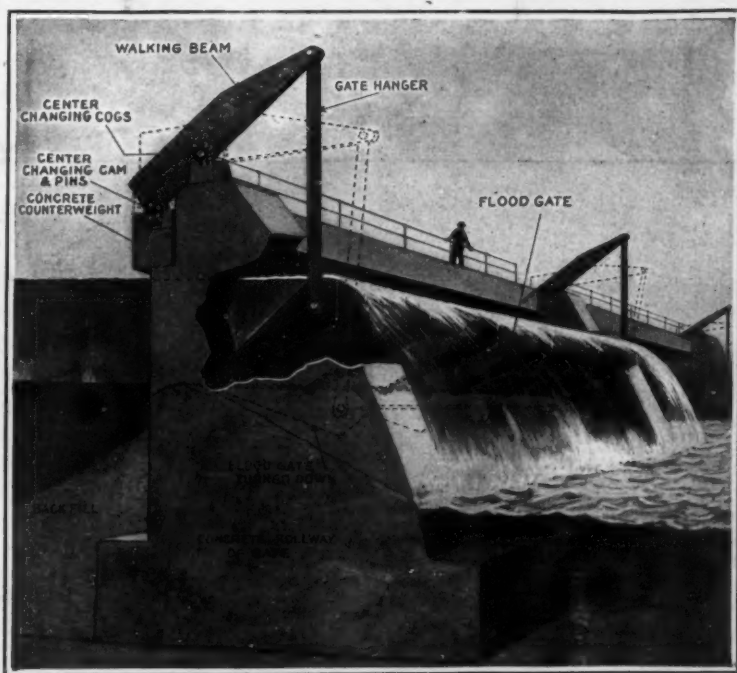
The height of a storm on the Massachusetts cliffs

the cliffs. Terrible nights are these in which the air is filled with blinding sleet and snow, and the sea with jagged ice and wreckage. Tearing the seaweed and the kelp from their moorings, gathering the driftwood of countless wrecks, and even seizing the stones in their



A winter-time view of the automatic flood gates, showing them in closed position

pathway, the waves hurl them all with uncontrollable fury against the cliffs. Mountains of foam rise grandly over a hundred feet in the air, the ground on which one stands seems to tremble, and only with the utmost difficulty may one avoid being swept away by the gale.



Section through the automatic flood gate showing, by dotted line, its position when fully opened

Many the hapless schooners, seeking the port of Boston, that have left their whitened timbers strewn along this shore. Many the crews that have fought in vain for life, escaping the cruel rocks of Nahant, only to be driven by the gale across the bay into the jaws of death on these dread ledges. One terrible winter night, amid the enveloping darkness of a great blizzard, a bark from Spain came laden with wine, seeking safe harbor at Boston. Losing their reckoning, dragging their anchors, helplessly awaiting their doom, all the sailors reached their final haven that night. The following day their bodies were found rolling in the snow-filled surf by their comrades of the sea, the Swampscott fishermen. Across the outlying rocks were the anchor chains of the bark, and amid the wreckage was its name, "Tedesco." Long years have passed, and over the sea have swept unnumbered storms; but still, on wintry days, between their games of chess and checkers, the fishermen tell us why these rocks are called Tedesco. Only a little later the "Fred Bliss," bound for Boston from the same port as the "Tedesco," was driven one night high upon the near-by rocks of Galloupe's Point. Fortunately the all-but-frozen crew were able to make their way to land where they broke into a summer cottage and found safety until the coming of morning.

To love the sea and to respond to its varied moods is to find enlargement of soul. Its silent depths have claimed the hopes and the lives of an unnumbered multitude. Are there not hours in which one may hear it voice the mingled joys and sorrows of a common humanity? To the listening soul the sea is a wondrous harp on which the chords of life sound clearly.

The scenery of the California coast is always delightful, whether we wander over the sand dunes and morning glories of Point Pinos, among the wave-worn cliffs and gray cypresses of the Monterey peninsula, or in view of the purple mountains at Santa Barbara. Unknown to the North Atlantic coast are the wonderful blues and indigos of the water, the flying

(Continued on page 82)

Flood Gates That Take Care of Themselves

AT Nashua, Iowa there is a very interesting dam which impounds the waters of Cedar River for a hydroelectric plant. The dam is a concrete structure, 17 feet high. The most interesting feature is the means of keeping the water at a constant level back of the dam. Cedar River in time of flood rises rapidly and has a very swift current, and so flood gates were installed in the dam which would open automatically in proportion to the increased pressure of the water and prevent an excessive rise of water back of the dam. The design of the gate was borrowed from Switzerland where such structures are not uncommon. It consists of a pair of gates, each hinged at the bottom and connected at the top to a pair of walking beams. At the opposite end of the beams there are counterweights of concrete.

Each gate is 46 feet long and is arranged to hold back a constant head of 7 feet. When the water rises, the gate swings down, and the counterweight is lifted. To compensate for the increase in leverage of the outwardly swinging gate the fulcrum of the walking beams is correspondingly advanced. This is effected by the use of toothed wheels on the beams, engaging racks mounted on the concrete buttresses of the dam, so that a rolling fulcrum is provided. A certain amount of adjustment is furnished in the means of attaching the counterweight to the beam. Cam links are provided, as shown in the accompanying drawing, with a number of openings at various distances from the center, in which the connecting pins may be located.

The gates are of steel covered with wood planking, and leather is used to prevent the water from leaking through the hinge joint and also around the ends between the planking and the buttress walls.

submarine the angle of departure of a curved course is practically impossible of determination.

During a long course of experiments in curved-course steaming, it was found that the retardation on the curved course with the easy angle of helm used, at all times is less than the whole retardation for a vessel steaming on a zigzag course in which the changes of course are through a large arc.

Automatic Course Indicator

The automatic course indicator was prepared with the following ends in view:

1. To enable a ship to steer zigzags, scientific "S" courses, spiral curves, or combinations of them, with precision.

2. To impose upon the helmsman in such navigation no duty in addition to the one to which time and experience have accustomed him—namely, that of watching the compass and maintaining in alinement on it the normal compass-mark with a lubber-line.

3. To supply the navigation officer and helmsman at all times with definite information, in intervals of time and units of distance, relative to the position of the vessel on the zigzag, "S" course, or curve, and relative to the normal straight course.

4. To provide an instrument suited to any vessel, whatever her speed, and whatever her variations in speed, her size and other characteristics, and adaptable to any type of compass, magnetic or gyroscopic.

Ships are now navigated by using the helm so that what is known as a "lubber-line" on the fixed compass rim, which line is set in line with the vessel's longitudinal axis, is kept opposite a selected compass mark on the compass card. Thus if a vessel proceeding north be desired to go east the helmsman turns the ship until the east mark of the compass is opposite the lubber-line. If, however, the lubber-line were not set in line with the ship's axis, but were positioned on the fixed compass rim, say fifteen degrees to the right or starboard of the longitudinal axis of the ship, then the vessel would not be steering north, but 15 degrees to the west of north.

Conversely, if the lubber-line were moved to the left or port and the vessel were turned accordingly, the ship would be found to be heading east of that compass direction, the same number of degrees as the line was moved to the left of the longitudinal axis line of the ship.

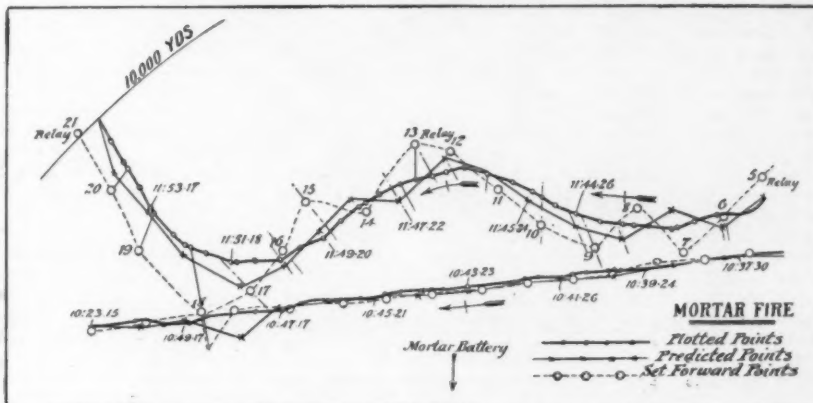
The principle of the course indicator is as follows: A lubber-line is marked on a rim which is rotatable about the compass card. If the line is moved to the

follow, the ship will automatically, because of the movements transmitted to the lubber-line from the cam, steer the desired course. A ship will carry several of these cams for as many different courses as may be desired.

Curved Courses and Gunfire

The value of the curved course as a protection against gunfire, whether from an enemy ship or a shore emplacement, will be evident at once, and Mr. Bates has published a description of the employment of the course indicator, during a special maneuver of a ship, made before a certain coast fortification with the permission of the military authorities. The description of this interesting test follows:

"Mortars are the main coast defense reliance. It is publicly known that they are generally fired in view of three observations, taken at 0 seconds, 30 seconds and 1 minute. The angles and ranges noted on these occasions are used, with corrections, to locate the so-called 'prediction point' at the 2d minute and the 'set-forward point,' which adds the time of flight of the projectile, and is the point at which the shell is aimed to fall. In the case of mortar fire, with its high trajectory, this is between 45 seconds and one minute for most ranges. It is the practice to calculate, therefore, for mortar fire, the future position of a vessel from one and three-quarters to two minutes ahead. On a





Battleplane Armament

From the Automatic Pistol of the Early Airman to the Multi-Gun
Fighting Airplane of Today



ALTHOUGH highly imaginative writers had predicted battles in the air between rival fleets of airplanes, the great nations entered the European war with little thought of arming their machines. They did not expect battles between airmen; for, as they thought, there was plenty of other work for airmen to perform. So with marked military conservatism the great powers did not arm their planes; and the only weapons the airmen had were their automatic pistols, and, in isolated instances, infantry or cavalry rifles which were to be used in the event of a forced landing behind the enemy lines.

The airplane was looked upon as a super-scout or a sort of winged cavalry, so to speak. It was considered quite possible that airplanes might serve for bombing purposes; but the poor results obtained with the steel arrows, crude bombs and bombing equipment of the early days served momentarily to convince the military men that the first duty of the airman was that of super-scout. Meanwhile the Germans had gone deeply into the matter of military aviation; and when the war opened they were ready to employ their airmen in the regulation of artillery fire. Indeed, the excellent marksmanship of the long-range German artillery at the beginning of the war was admitted to be marvelous by the Allied armies, until they too learned the art of aerial spotting.

It did not take the French pilots long to "get on" to aerial scouting and spotting, despite the numerous handicaps confronting them. By October 1st, 1914, the French airmen were prying into the affairs of the German commanders in the most disconcerting manner to the latter. From his high perch the military airman could sketch and jot down notes of enemy dispositions and activities, and then fly back with that invaluable information to his headquarters. This had changed all warfare. Was there to be no more secrecy in military activities? Were one's plans and actions to be an open book to the enemy?

Both the Germans and the Entente armies soon came to the full realization of the aerial scout's activities. Each side decided to push its aerial scouting activities to the utmost, while hampering the enemy's as far as possible. Thus the offensive and defensive tactics were introduced in aerial activities, and soon the planes took machine guns aboard and went forth to battle.

From the light-hearted way in which rival airmen passed each other in the skies during the opening days of the war, merely waving their hands or shaking their fists at one another, they went to a real belligerent spirit, bent on destroying the enemy whenever possible. As early as August 15th, 1914, a Paul Schmitt biplane of the French which had been shot down by the German anti-aircraft gunners, was found to be equipped with a machine gun and 200 cartridges. By November practically all the Voisin biplanes of the French were

armed with machine guns. Records show that the first airplane downed in aerial combat was shot down on October 5th, 1914, by Sergeant Frantz of the French army, in company with his mechanic, Quenault, both of the Escadrille F-24, composed entirely of Farman "pusher" biplanes. Frantz and Quenault engaged an Aviatik biplane at a height of 5,000 feet, and after a few shots the German machine crashed to earth in a little wood behind the French lines. The pilot had been killed outright by a bullet, while the passenger, a Prussian nobleman, died before he could be pulled out from under the wreckage which had burst into flames. During the aerial fighting of 1914 not a single French pilot was shot down in aerial combat, such losses as were incurred being due to fire from the ground, which was then particularly efficacious because of the low altitude at which the machines were flying.

December, 1914, saw the "fifth arm" of the French army formally consecrated to its due share of the great

bands of German aerial warriors, which came to be known as "tango circuses" and "traveling circuses" in some instances, proved the system to be utterly wrong when dealing with an enemy having the initiative of attack. Accordingly, the chasing escadrilles were grouped under a single command and the immediate protection of the army corps machines was left to the latter, which soon had to assume a more or less defensive attitude in carrying on their work. Nevertheless, it was the formation of the separate chasing escadrilles which permitted the Entente armies to meet the aerial offensives of the traveling German escadrilles, thus restoring aerial balance of power whenever necessary, gaining supremacy of the air at a given point during an Entente offensive, and raising the morale of all Allied airmen all along the line.

The single-seater fighter or chaser or scout, as it is variously termed, was born of the demand for a fast and readily maneuvered machine. It brought about the great competition between the Germans and the

Allies of producing faster and better fighting planes; for the scouts, like the battleships of the navy, are the real basis of aerial fighting power. An air fleet may be made up of large numbers of reconnaissance and photography planes, bombing planes, and other machines for the routine work of aerial warfare, but when it comes to battling the single-seaters determine the issue.

In the beginning the single-seaters were generally monoplanes, and the aircraft constructors made use of the knowledge gained in developing high-speed types for the great races before the war. In fact, some of the single-seater or monocoque Deperdussin racers were employed by the French at first, for the reason that they quite outraced anything the Germans had. But it soon dawned on everyone that a scout had to be a good fighter; so the monoplane design was more or less abandoned in favor of fast biplanes which could carry the necessary armament.

How to mount the machine gun so that it could be brought to bear on the enemy was one of the great problems. In the first monoplanes attempts were made to mount the machine gun high above the airman, so that its line of fire would be above the sweep of the propeller blades. However, such construction was exceedingly awkward for the aerial fighters, if not decidedly dangerous, since the airman had to stand in order to operate the gun; and standing in a machine making better than 90 or 100 miles an hour is not the most pleasant of sensations. The accuracy of one's fire in such a position can well be imagined.

Now the two-seaters of those days were also confronted with the machine-gun problem. In the "pusher" type, where the propeller is behind the wings, the machine gun merely had to be mounted in front of the observer.

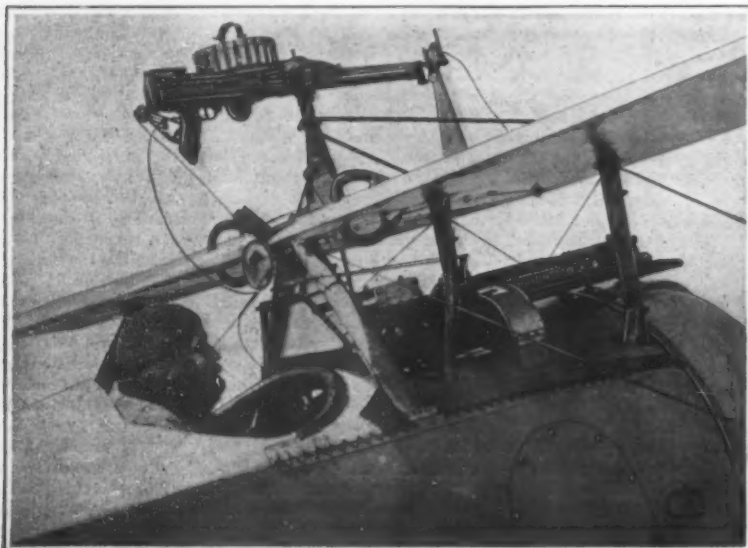


Morane-Saulnier "parasol" scouts employed in the early days of the war

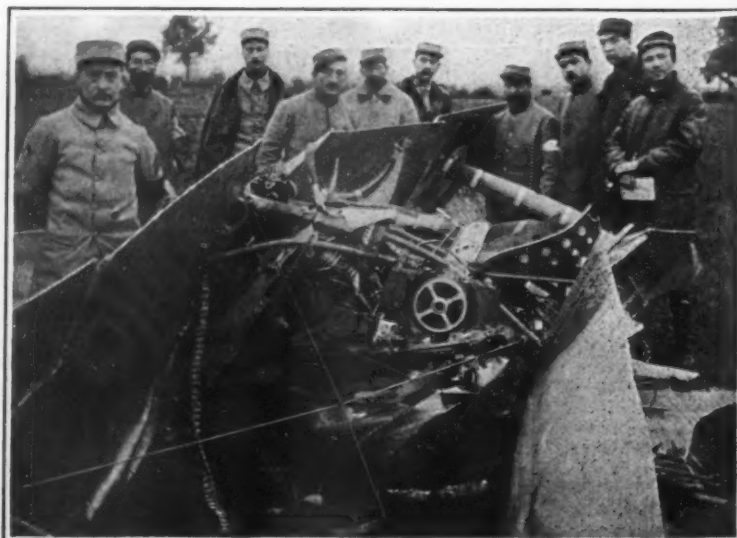
war. The airplanes were divided into escadrilles for strategic reconnaissances and for chasing enemy machines; the army corps escadrilles for photography, observation, and artillery fire regulation, comprising the regular routine of military aviation; and the bombardment escadrilles for the bombing of enemy works.

The Germans followed suit, as did the British whose aerial fleet was fast developing into a giant organization from an almost insignificant showing at the outset of the war. The first French chasing escadrilles were created at the end of 1915. There were few of these fighting units in existence when the Lafayette Escadrille was formed, April 17th, 1916. The chasing escadrilles, operating freely in assigned zones, were intended to bar the skies for enemy machines and to provide protection for the army corps machines engaged in routine work.

Up till 1916, the army corps escadrille was considered the fundamental base of the aviation system; but the battle of Verdun and the growing aggressiveness of roving



Heavy armament of a Nieuport scout: A Lewis gun above and a Vickers machine gun on the engine cowl



Wreck of a French Nieuport scout, showing the Vickers machine gun and ammunition belt

Such a machine, however, could only bring its machine gun to bear when acting as the pursuer. If an enemy machine happened behind it, there was no way of shooting rearward. In the case of the "tractor" type, where the air-screw, to give it the proper name, is in front of the wings, the machine gun was mounted behind the pilot and the observer, so as to shoot at any angle back of the machine. But if such a machine happened to be chasing another machine—well, it simply couldn't act as a pursuer for the reason that it couldn't attack. So the pusher and the tractor types were automatically obliged to act on the offensive and defensive, respectively; which, as is quite obvious, was an awkward state of affairs.

The problem of mounting the machine gun in front, even in the tractor design which had come into favor because of certain structural and aerodynamical advantages which could not be sacrificed even for the sake of armament, was first solved by the French. They mounted a St. Etienne type machine-gun, which is clip-fed, on the engine cowl directly in front of the pilot. The gun was rigidly mounted, and the pilot, whether in a single- or two-seater machine, brought to bear on the target by aiming the entire machine. Thus the pilot's hands were left more or less free to manage the airplane, as in more peaceful times. The line of fire necessarily passing through the sweep of the air screw in front, the French placed small pieces of steel or "deflector plates" on the parts of the screw blades which cut the line of fire. In that manner such bullets as struck the propeller were deflected by the steel blades without causing damage. Such an arrangement, to be sure, entailed some loss of ammunition, since the deflected shots were wasted. But the greatest handicap was in the loss of speed, which is said to have averaged 10 miles an hour, due to the retardation of the air screw. And in the gruelling competition between rival airmen this loss was far too serious to be permitted to stand.

For a time the French mounted a quick-firing cannon on their Voisin "pushers" with the object of more readily destroying some giant planes which the Germans were employing early in 1915. But the difficulties of aerial marksmanship alone compel the use of a machine gun with tracer bullets, because of the greater number of chances of hitting the enemy. Again, machine-gun fire is quite sufficient to account for the crew of an airplane, and, with the use of incendiary bullets, the machine itself. So the *avion-canon*, as the French called that type, was soon abandoned.

By now the Germans had come along with an ingenious synchronizing mechanism, whereby the machine gun, mounted on the engine cowl, could fire through the tractor air-screw sweep between times, so to speak. That is to say, by mounting a cam on the engine shaft, and running a transmission system of levers and bell cranks from this cam, the gun mechanism was only operative at such times as the line of fire was clear of the air-screw sweep. The Fokker machine which the Germans employed in 1915, and which proved the terror of the Allied airmen because of the heavy toll which its pilots collected, was equipped in this manner. The German pilot merely maneuvered his Fokker until the sights bore on the target, and then pressed a trigger



Typical German chaser—an Albatross in this case—equipped with twin machine guns on the engine cowl

release; whereupon the gun automatically fired between the passing blades.

Early in 1916 the Allies were ready to combat the Fokker with the Nieuport biplane, in which the machine-gun was mounted on the upper plane, clear of the air-screw sweep, and operated by a Bowden wire control on the "joy stick." There were several variations of the Nieuport armament; but the standard one was a single Lewis gun with a single pan of ammunition containing 49 rounds. After discharging the pan or drum, the airman had to come down for another. While the gun performed splendidly and could be accurately aimed by the sights on the engine cowl in front of the airman, the limited supply of ammunition was a serious objection. Soon pilots began mounting an extra machine-gun, usually of the Vickers belt-fed type, on the engine cowl, using a synchronizing device to take care of the air-screw sweep. Other airmen preferred two Lewis guns mounted side by side on the upper plane, with individual Bowden wire controls. Thus if one gun jammed, ran short of ammunition, or became otherwise inoperative, its mate could be brought into play. Still other airmen arranged the Lewis gun on a trunnion, so that it could be tilted with the butt end in the airman's hand. This arrangement was found excellent while attacking a machine from below. In fact, the same arrangement is still in use on the recent British SE-5 scouts.

The synchronized machine-gun arrangement having proved its worth, it soon became the standard of all air fleets. All Allied and German chasers and two-seaters of the tractor type were and are still thus armed. From a single machine-gun, many airmen have gone to two, mounted side by side on the engine cowl and so aligned as to have their fires cross at a point a hundred yards or so in front. Guns mounted in that fashion can be used singly or in pairs, by means of trigger controls on the "joy stick," and the airman is not so liable to be caught with an inoperative gun.

As for the sights employed on scouts and reconnaissance planes of the tractor design, these vary from simple

open sights to elaborate telescopic sights. The open sights generally take the form of a simple ring with cross wires for the rear sight, and a standard topped with a small ball for the fore sight. The telescopic sight is equipped with cross hairs. A chin rest or a forehead rest is often provided so that the airman can steady his head while taking aim.

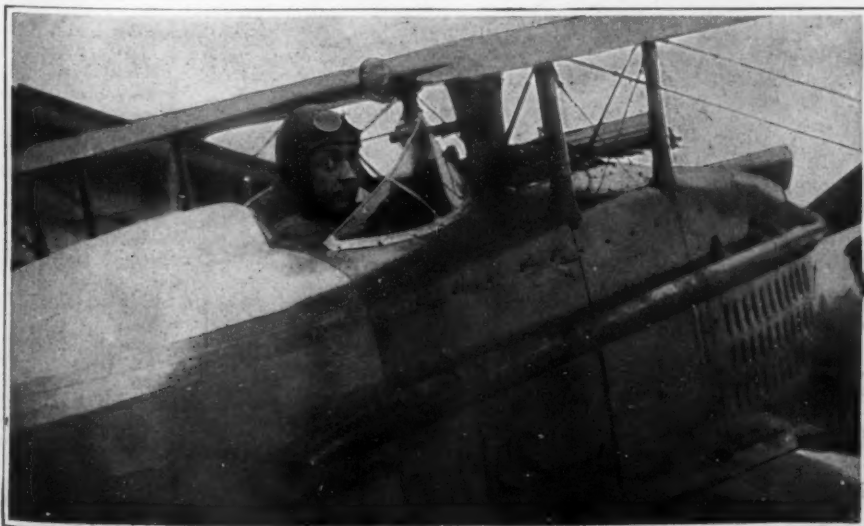
Meanwhile the armament of the two-seater machines of both Germans and Allies closely followed that of the scouts so far as practicable. The prevalence of the tractor type gave rise to the rigidly-mounted synchronized gun or guns in front, operated by the pilot, and single or twin guns for the observer in the rear cockpit. At first a simple goose-neck mounting was employed for the rear gun, but the Germans introduced a most ingenious mounting in the form of a revolving ring, an adjustable yoke, and a stool turning in conjunction with such a gun rest. Thus as the observer swings about to any point of the horizon, the gun turns with him and always remains in front. A locking device permits of first locking the revolving ring in place, then locking the yoke rest when the proper elevation has been obtained, and then the gun. This arrangement, variously known as the "turrette," "ring mount" and the "scarf yoke," has become standard for all air fleets.

Up till the signing of the armistice the armament of all planes had been pretty well standardized. In the case of twin-engined planes, where the air-screws, being on either side of the body, are not in the line of head-on fire, the usual arrangement calls for a turrette for the front cockpit and another for the rear cockpit. In some instances, twin guns are mounted to preclude gun trouble. Two-seater reconnaissance or general utility planes, such as our DeHaviland Fours, being equipped with a tractor screw, have a standard armament consisting of rigidly mounted gun or guns on the engine cowl, and a turrette for the rear cockpit. Scouts are invariably equipped with one or two guns, either rigidly mounted on the engine cowl or on the top plane. For the rigidly-mounted guns the air-cooled, belt-fed Maxim is standard with all air fleets.

For the turrette mounting the Lewis gun, stripped of its large cooling tube, has been used by the Allies because of its pans or drums which can be readily handled. The Germans, on the other hand, have made use of a modified Maxim with a very light, perforated cooling tube and a reel mechanism for handling the ammunition belt. This gun is known as the Parabellum.

In naval aircraft the armament has followed military practice wherever feasible. Such seaplanes as have been actively engaged against U-boats have in many instances been equipped with the Davis non-recoil gun, firing a 1½- or 3-inch shell. The mounting of such a gun has been of the simplest, consisting of a swivel and trunnion. In the majority of seaplanes, however, machine guns have been used. The armament of the large flying boats employed against the U-boats by the British and American naval forces, has generally been a turrette for the front cockpit, another for the rear cockpit, and often two guns firing through port holes in the sides of the huge, boat-like hull.

(Continued on page 85)



The famous French Ace, Guynemer, in his Spad chaser equipped with a single Vickers machine gun and telescopic sight



Two-seater British reconnaissance machine, showing telescopic sight forward and "turrette" mounting for rear gun

The Principles of Camouflage—I

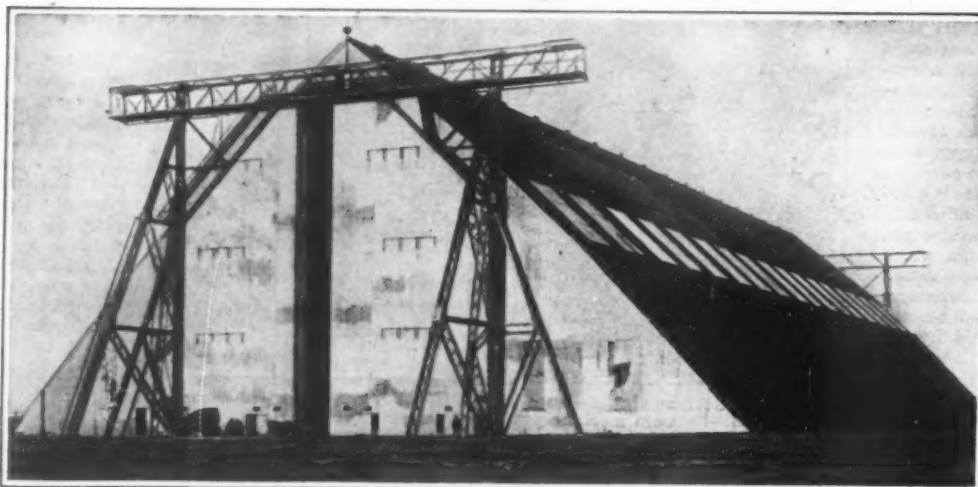
The Art of Concealment and Deception as Practiced on Land

By M. Luckiesh

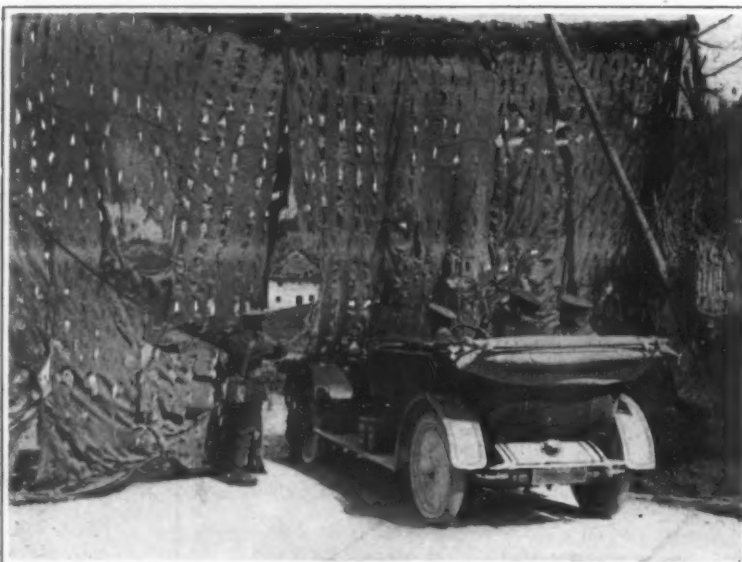
CAMOUFLAGE is an art which is the natural outgrowth of our instinct for concealment and deception when pitting our wits against that of a crafty prey or enemy. It is an art much older than the human race for its beginnings may be traced back to the obscurity of the early ages of the evolution of animal life. The name was coined by the French to apply to a definite art which developed during the Great War to a high state as many other arts developed by drawing deeply upon the resources of scientific knowledge. With the introduction of this specific word to cover a vast field of activity in scientifically concealing and deceiving, many are led to believe that this is a new art. But such is not the case, however: like many other arts such as that of flying, the exigencies of modern warfare have provided an impetus which has resulted in a highly developed art.

Scientists have recognized for many years, and perhaps more or less vaguely for centuries, that Nature exhibited wonderful examples of concealment and deception. The survival of the fittest, as Darwin expressed his doctrine, included those individuals of a species who were best fitted by their markings and perhaps by peculiar habits to survive in the environment in which they lived. Naturally markings, habits and environment became more and more adapted to each other until the species became in equilibrium with Nature sufficiently to insure its perpetuity. If we look about us upon animal life we see on every hand examples of concealing coloration and attitudes designed to deceive the prey or enemy. The rabbit is mottled because Nature's infinite variety of highlights, shadows, and hues demands variety in the markings of an animal if the latter is to be securely hidden. Solid color does not exist in Nature landscapes in large areas. The rabbit is lighter underneath to compensate for the lower intensity of illumination received on these portions. As winter approaches, animals in rigorous climates need a warmer coat and the hairs grow longer. In many cases the color of the hairs change to gray or white providing a better coating for the winter environment.

Animals are known to mimic inanimate objects for the sake of safety. For example the bittern will stand rigid with its bill pointed skyward for many minutes if it suspects an enemy. Non-poisonous snakes resemble poisonous ones in general characteristics and get along in the world on the reputation of their harmful relatives. The drone bee has no sting, but to the casual observer it is a bee and bees generally sting. Some animals have very contrasting patterns which are conspicuous in shape yet these very features disguise the fact that they are animals. Close observation of fishes in their natural environment provides striking examples of concealing coloration. Vast works have been written on



A huge Zeppelin shed with roof extending to the ground, eliminating shadow-casting vertical walls.



A road screen in Italy to prevent detection of traffic which could be viewed from the enemy lines.



A 16-inch railway mount camouflaged in a clump of trees.

this subject by scientists so it will be only touched upon here. Mr. G. H. Thayer's "Concealing Coloration" is a very readable volume for the average reader.

There are many examples of "mobile" camouflage to be found in Nature. Seasonal changes have been cited in a foregoing paragraph. The chameleon changes its color from moment to moment. The flounder changes its color and pattern to suit its environment. It will even strive to imitate a black and white checkerboard.

In looking at a bird, animal, insect, or other living thing it is necessary to place it in its natural environment at least in the imagination before analyzing its coloration. For example, a male

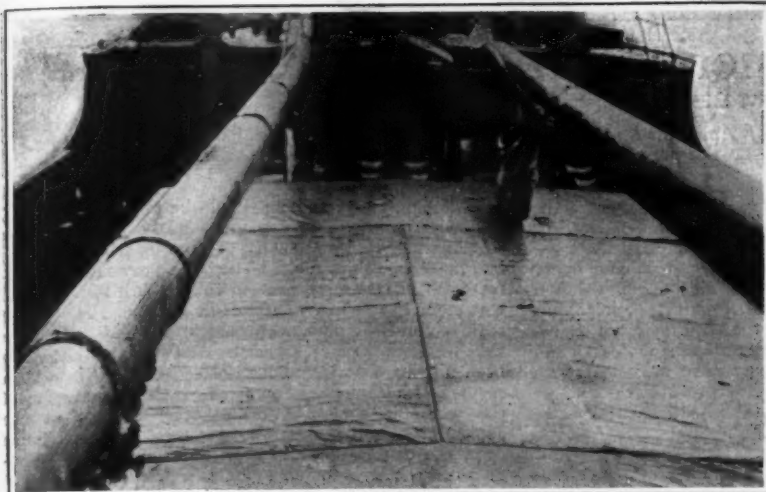
mallard duck hanging in the market is a very gaudy object, but place it in the pond among the weeds, the green leaves, the highlights, and the shadows and it is surprisingly inconspicuous. The zebra in the zoo appears to be marked for the purpose of heralding its presence anywhere in the range of vision, but in its reedy, bushy, grassy environment it is sufficiently inconspicuous for the species to survive in Nature's continuous warfare.

Thus studies of Nature reveal the importance of general hue, the necessity for broken color pattern, the fact that black spots simulate shadows or voids, the compensation for lower illumination by countershading, and many other facts. The artist has aided in the development of camouflage but the definite and working basis of all branches of camouflage are the laws and facts of light, color and vision as the scientist knows them.

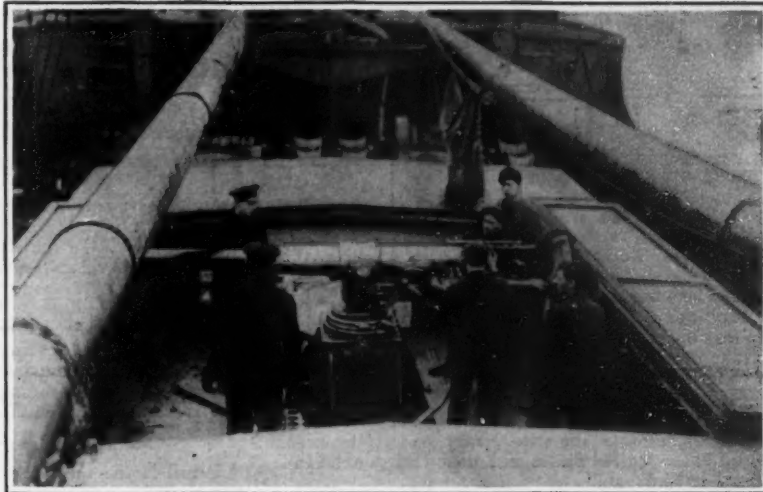
Just as lower animal life has unconsciously survived or evolved by being fitted to do so mankind has consciously, or at least instinctively, applied camouflage of various kinds to fool his prey or his enemy. Many of us in hunting ducks have concealed the bow of our sneak-boat with mud and weeds, or in the season of floating ice with a white cloth. In our quest of water fowl we use decoys and grass suits. The Eskimo stalks his game behind a piece of ice. In fact, on every hand we find evidences of this natural instinct. The Indian painted his face and body in a variety of colors and patterns. Did he do this merely to be hideous? It seems very possible that the same instinct which made him the supreme master of woodcraft caused him to reap some of the advantages of concealment due to the painting of his face and body.

In past wars there is plenty of evidence that concealment and deception were practised to the full extent comparable with the advantages or necessity. In the Great War the advent of the airplane placed the third dimension in reconnaissance and called for the application of science in the greatly extended necessity for concealment and deception. With the advent of the air-

(Continued on page 85)



False hatch of the decoy ship "Suffolk Coast" in the closed position, concealing a 3-inch gun



When the U-boat was within point-blank range the hatches were thrown open, disclosing gun and crew

Decoy Ships for Submarines

Some Details of Naval Actions Which Brought the Victoria Cross

"ALL the world loves"—a sailor, when he is of the heroic type of the men in our own and the Allied services, who when duty called have not stayed to count the cost. From time to time our Navy Department has told the story of valorous deeds done by our officers and men upon the high seas, and here and there, men on returning ships add to the brilliant record. All the Allied navies have contributed their quota of recorded heroism to brighten the tragic histories of this great war on sea and land.

Recently the British Admiralty have made known why the Victoria Cross was awarded to certain naval officers and men during the war. It seems that the coveted decoration was won upon certain ships, whose existence and operations were kept a profound secret during the war. These were special craft of the "mystery" type, which carried a camouflaged anti-submarine battery and were manned by carefully selected volunteer crews. Outwardly, they bear the appearance of small tramp steamers or sailing craft of the kind that engaged in the coastal trade around the British Isles.

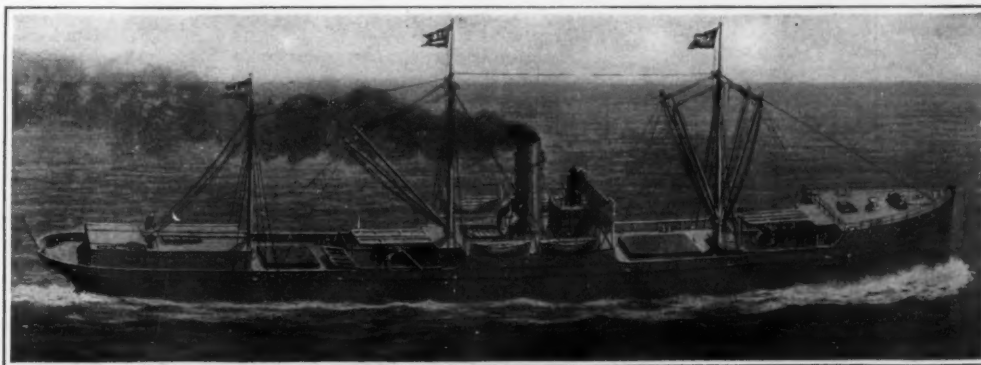
We present photographs of one of these ships, and a sketch, which our artist has drawn with a view to showing more clearly the methods adopted for concealing the fighting character of the ship. The favorite method of concealment was to mount the guns in false deck houses or beneath false hatches, the sides, ends, and ceiling of which were hinged and connected with mechanism which

enabled them in a few seconds to be dropped or folded back, exposing the concealed gun and gun crew with their weapons trained directly upon the U-boat.

To enable the commander to keep an eye on the U-boat, a periscope disguised as the chimney of a stove was emplaced in a position where it commanded an all-round view. The conning tower had the appearance of a large coil of rope, while another pile of heavy rope served to

made for some waters where submarines had recently been reported, or where they were wont to foregather, and steamed or sailed along as though she were on a peaceful merchant voyage. When the submarine was sighted, she made every apparent effort to get away, though as a matter of fact, the vessel would be slowed up gradually so as to bring the submarine within range as soon as possible. In some cases she would carry an

after gun, either real or dummy, such as was mounted on merchant ships, and would even engage in an exchange of shots. The crew of the ship was divided between the actual fighting crew who remained carefully concealed, and what was called the "panic party," who, when the vessel was heavily shelled or had been struck by a torpedo, would make a rush for the boats and pull away from the ship. When the submarine had come up within point-blank range, the false hatches, tarpaulins, and other camouflage would be flung open and the guns would open up at a range so



A typical decoy ship, with forward and midship false deckhouses thrown open revealing the guns, and the after deckhouse closed

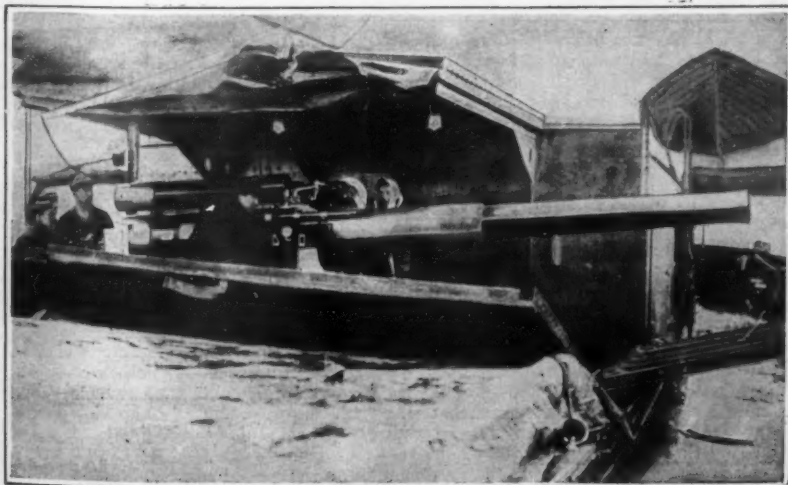
hide the connections for the auxiliary wireless aerials. Such officers and members of the crew as must needs put in an appearance on the ship, were dressed as civilians, the designer of the "Suffolk Coast," Lieutenant-Commander Auten, V. C., wearing an ordinary sack suit and a soft fedora hat.

The strategy and tactics (if we may use the term here) of these remarkable craft were as follows:

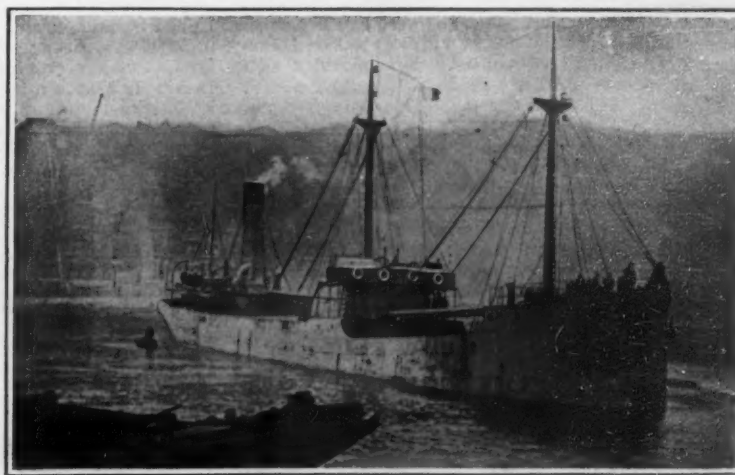
The vessel (tramp or steamer, as the case might be),

close that the destruction of the U-boat was certain. It will readily be seen that since these little craft, which sometimes were small sailing schooners, had to offer themselves as a target for the 4-inch and even 5.9-inch shells and the torpedoes of the submarine, the venture was one requiring remarkable discipline and a complete disregard of one's life. But perhaps the work can best be told in the words of the official dispatch.

(Continued on page 88)



The hinged roof of this deckhouse folds back upon itself and the sides fall down, revealing the gun



The decoy ship "Suffolk Coast," apparently a harmless tramp of the kind beloved by the U-boat commander

World Markets for American Manufactures

Edited by LYNN W. MEEKINS

A department devoted to the extension of American trade in foreign lands

Our Opportunity in Brazil

BBETTER delivery service is at present the greatest need of North American exporters selling their goods in Brazil," said the representative of a commission house which has branches in South America. "We have hundreds of orders on our books, and the consignments are awaiting shipment, but there are not enough vessels to take them. At least 70,000 tons of cement are ready to go forward, as are thousands of dollars' worth of agricultural implements, shoe-making machinery and shoe findings. We must have more ships soon or the Brazilian merchants, already impatient, may cancel the orders placed in the United States and make their purchases in Europe or in Japan."

Brazil is one of the largest and richest countries in the world, and opportunities to develop its resources are unlimited. The Brazilians are more friendly to us than are any other people of Latin America. A market in which Germany was strongly entrenched before the war, Brazil offers many chances today to American manufacturers. The typewriter is one American product that is making considerable headway just now. Since last summer the Brazilian Government has permitted contracts with its various departments to be presented in typewritten form. In the past, documents of all kinds have been written by hand, but this practice is being abandoned since the advent of American salesmen, who have introduced standard typewriting machines and have organized schools where stenography and type-writing are taught.

American Dental Equipment in Wide Use

For some years the United States has enjoyed a very satisfactory part of the Brazilian trade in dental instruments and supplies. Nearly all of the 1,500 dentists in Brazil are natives of that country, largely because of the rigid examination given in the Portuguese language that must be passed before dentistry may be practised. "Dental parlors in Rio de Janeiro are like those in the United States, as most of the equipment is of American manufacture," said a man who has lived in that city. "Because several American manufacturers of dental chairs increased their prices, German-made chairs of inferior quality, sold at a much lower figure, were cutting into our share of the trade just before the war. Customs duties are high and Brazilian importers are better able to dispose of the less expensive chairs."

The great central part of Brazil is the least known of any section of the world. Although literally darker than Africa, it is not lacking in modern requirements. For one thing, sewage disposal systems are needed, which means an excellent opportunity for the development of trade in pipes and machinery for such plants. The agents of American firms who have visited Brazil have been too prone to confine their attention to the large coast cities and have neglected the interior of the country, where farming and the raising of live stock are growing in importance. To encourage these industries, the Government has removed the import duties on farm implements and on pure-bred cattle and horses.

Brazilian Cities Are Well Lighted

As an indication of the extent of the market for electrical supplies, in the state of Sao Paulo alone, 160 cities and localities are provided with electric lighting facilities. It is reported that American electrical irons, toasters and other devices could find an increased sale in Rio Grande do Sul through intelligent sales methods, which would include correspondence with dealers conducted in Portuguese, the sending of attractive literature accompanied by a statement of terms, prices and discounts, and the supplying of data showing the volume and weight of goods packed for export. In this section of Brazil, German houses have been successful in controlling most of the importation and distribution of foreign goods. But this has not prevented the sale of American electrical supplies, which have proved their superiority.

Brazil is a good market for American drug products and pharmaceutical supplies. It is said to use more perfume in proportion to the population than any other country in South America. Many well-known American

proprietary medicines are popular in Brazil, where the people are noticeably inclined to use such remedies for their ailments. In the city of Rio de Janeiro there are more than four hundred retail drug stores, and every village has at least one such establishment. Malted milk and grape juice are typical American articles that have been sold successfully in the larger cities of Brazil. The best way to place American products of this sort on the market is to send travelling salesmen to introduce the goods and appoint competent representatives. Some American manufacturers have established branch factories.

Market for Paper and Other Products

Brazil is the second largest consumer of paper and paper products in South America, importing more than \$13,000,000 worth in 1916, but the outlook for an increased trade in this line is not promising because of the country's slow educational development. About three-fourths of the population can neither read nor write. The expansion by the Brazilian Government of the public school system would result in a larger demand for paper and for many other commodities. In two of the three great manufacturing cities of South America—Rio de Janeiro and Sao Paulo—there is a good field for the sale of industrial machinery, especially that of an intricate nature.

"Our manufacturers need more direct representation in the important trade centers of Brazil," declared an American trade commissioner just returned from South America. "We need also a fast and regular freight

In foreign trade nothing should be taken for granted. Its changes are kaleidoscopic, its conditions ever varying, and he who would not keep up with the times had better stay out of it. There are very many manufacturers in this country who think there is not much chance of our selling anything in Europe. They have read so much about the preparations for after the war that England, France, Germany and other nations have been making that they have decided to draw into their shells so far as selling American goods in that part of the world is concerned. They still think that the American manufacturer who pays his workmen with dollars is unable to compete with the European manufacturer who pays for his labor with francs, leaving out of consideration the fact that the United States has the most raw materials as well as the finest machinery, with which the difference in wages may be overcome in many cases.

Very soon we shall have to increase our sales abroad or else face an indefinite period of hard times. Factories cannot be kept going unless the orders on hand are sufficient. The failure of a number of our manufacturers to realize the importance of foreign trade has thoroughly discouraged quite a few trained foreign representatives from handling American goods. A man of long commercial experience, born in Greece, who has spent more than ten years in the United States, complained bitterly the other day about the lack of interest in export business that he found in American industrial circles. He got in touch with a hundred factories, offering to open a well-equipped building in Athens where their products could be displayed and asking them to let him have samples of their goods, for which he agreed to pay, and descriptive catalogues. Although this man knows the Near East from A to Z and has ample capital to finance the undertaking, he received only two replies, but one of which was favorable.

"I can't understand why American exporters are not aware of their opportunities in the Levant," he said. "The United States will have excellent shipping facilities when its new fleet is built, and it will be an easy matter to inaugurate a steamship line from New York to Near Eastern ports. With 85 per cent of the trade of the Levant in the hands of Greeks, the best distributing centers are Athens, Patras, Saloniki and Smyrna. The long friendship of Greece for America makes these traders anxious to handle the products of the United States, which they will push energetically if given a chance. Prices are figured on a close basis out there, which means that direct trade is the only way that American goods can compete with those from Europe."

If the manufacturer will study the geography of Africa, he will find that Egypt contains something more than the Pyramids and the Sphinx. With land selling at \$1,500 an acre and a full measure of prosperity due to its high quality cotton crop, Egypt is a spirited bidder in the foreign market. Its purchases from the United States have increased very considerably in late years, and it is a field to which more attention should be paid. Our trade with Egypt has been handicapped in the past by the lack of direct steamship lines.

Our new foreign commerce will carry into all parts of the world many lines of American goods which used to be restricted to comparatively few markets. We are now sending abroad numerous commodities that we did not export at all before the war and some that we did not previously manufacture. Uncle Sam's general store has added lots of new departments. He can sell to his foreign customers a greater variety of lines than ever, thanks to the vast industries newly developed.

We have also progressed in the manufacture of chemicals, and instead of something just as good as those we used to buy from Germany, we are turning out something much better. With the diversion of industrial plants from war orders, their profitable operation depends upon the extent to which new foreign business replaces the military demands of the period now ending. Careful planning, based upon accurate information, and a greater degree of friendliness toward prospective customers are essential in the new order of things.

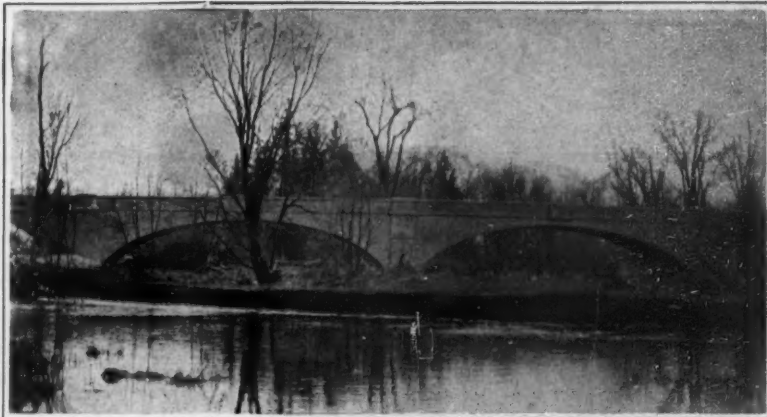


A display of American dental goods in Rio de Janeiro

service to all the principal ports. Without it we are as crippled as a department store that depends upon casual messenger boys to make its deliveries. To obtain more Brazilian business, we must extend more satisfactory credits. Brazil has every natural resource that the United States has, and others in addition. The investment of American capital in their development will create the largest single incentive to our trade with Brazil. We must pay more attention to advertising. Publicity methods in South America may be compared to those prevailing in the United States thirty years ago. The application of American ideas would make Brazilian advertising more effective and result in making thousands of our products as well known as the comparatively few American goods already standard with Brazilians. If they knew us better, the people of Brazil would buy more from us, but they have hardly any conception of our national life. At the present time they are interested in us and have met us half way by indicating their friendship."

The Renaissance of Commerce

THE business of war, which has dominated the world for the last four years, is now giving way to the business of peace, which will be by no means a peaceful business. "The war shook the dust off the world's trade and in its newness and brightness it is a wonderful and a dangerous thing—wonderful in its possibilities for the manufacturers and exporters with knowledge and vision, and dangerous for those without such qualities.



A highway bridge in Wisconsin and its twin brother. The use of the existing plans for the second structure was made possible by building it on dry land and diverting the river to flow under it

Quantity Production in Bridges

A COUPLE of years ago we discussed briefly the question of serpentine crossings, and showed that, whether the crossing were at grade or above or below, operating safety required the road to run in a single straight line, to include both the crossing itself and a considerable distance on either side. We pointed out that when this requirement was not met, the lessened first cost of constructing a perpendicular crossing, compared with a long diagonal one, was properly to be regarded as a secondary matter, as against the cost of maintenance and the great dangers of the serpentine crossing.

The same situation comes up frequently in building a bridge. The road approaches and leaves the river at a considerable angle, or at a point where the river bends in such a way as to give a long crossing. If the bridge is built at this angle so as to give a straight crossing, much additional constructional expense is involved. If, on the other hand, we put two kinks in the road, one at each end of the bridge, in order that the latter may be of minimum length, we are but lending our troubles to the future.

The bridge engineer has a way out of this dilemma—a way through which the constructor of a rail-highway crossing cannot follow him. The railroad is a permanent feature and cannot be shifted; but it is a simple matter to pick up the ordinary small stream and set it down in a new place. So this is what the bridge engineer does; he simply relocates the river at the point where he can bridge it most conveniently and economically.

Incidentally he derives another advantage from this procedure. Instead of first moving the stream and then building the bridge, he builds the bridge and then diverts the stream to flow under it. Obviously it is not a very great advantage to be able to build a bridge of ordinary size entirely on dry land—we could not go out of our way to do this. But when it comes to a question of whether we shall build our bridge on dry land, or build a river first so that we may build the bridge over water, we shall certainly decide in favor of the former alternative, and make it good for such incidental advantages as it possesses. It may, however, be emphasized that its economies are purely incidental; the big saving, the one we are after, is found in the difference between the cost of diverting the river and that of building an unnecessarily long bridge.

A Wisconsin engineer, in applying the procedure outlined, has recently demonstrated still another possibility that inheres in it. When we build a bridge at whatever point we happen to come upon the water, we must accommodate the structure to the width of the watercourse. But if we are going to plant our bridge in the middle of a field or lay it down parallel to the present course of the stream, as

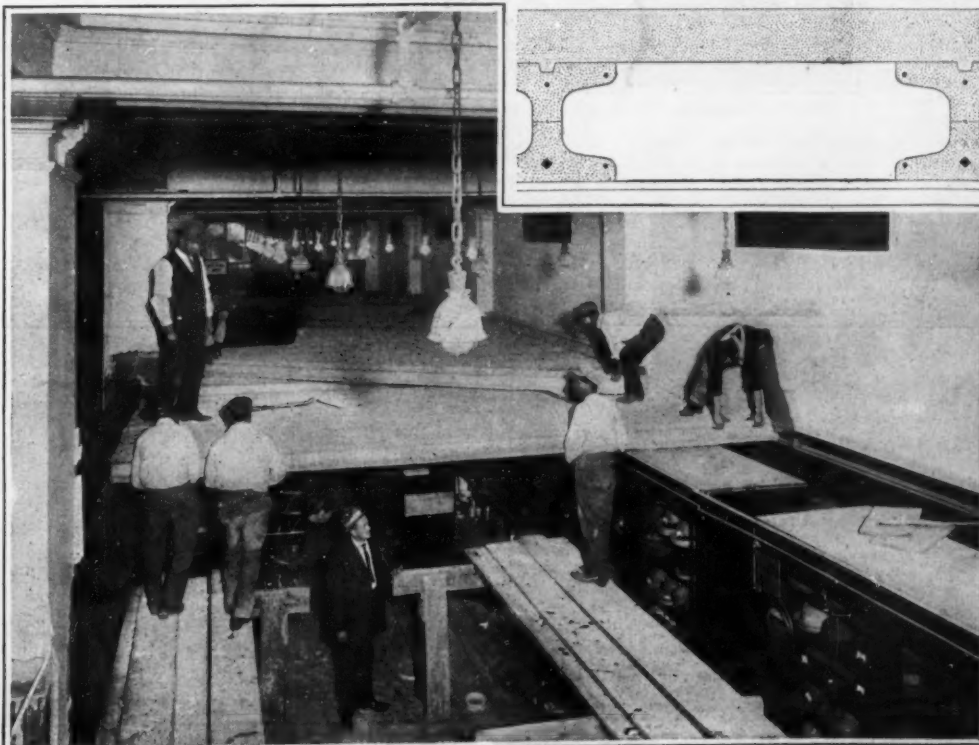
was done in one of the cases illustrated, when we get around to the job of relocating the river, we can make the width of the watercourse what we please—within limits, of course. That being the case, we can dig into our files for an existing bridge plan, and when we find one that we like and that comes within the limits of the present case, we can accommodate the renovated stream to it, instead of going to the expense of designing a brand new bridge to fit the stream.

This is actually being done in Wisconsin. The two bridges which we picture are located, one near Antigo and the other near Manitowoc; the natural spans, if the streams had in both cases been left undisturbed, would have been quite different in length and height of span, since the profiles of the valleys were wholly different. But in revising the river at Antigo it was easy to provide that, after its transfer to a new channel, it should duplicate that at Manitowoc so far as concerned its bridgeability; and incidentally it is now straight, where before it was crooked.

An Over-night Concreting Job

THE accompanying illustration shows the laying of a concrete floor at night with reinforced I-beam sections in a large department store at Cleveland. The spans in the construction were 20 feet, with a total load of 250 pounds per square foot. The erection was accomplished without the use of forms or supports of any kind, and even the removal of the many glass showcases standing on the store level beneath the floor slab was unnecessary.

The upper layer of concrete is used as a finished cement floor; while the ceiling plaster adheres perfectly to the lower surface without the use of any adhesive intermediary.



Concrete floor laid at night without disturbing the floor below; (upper right) the construction details

The Current Supplement

EVERY now and then the announcement is made that someone has discovered a method of creating life, but when the facts are examined it can hardly be said that we are appreciably nearer the goal than before. Many serious, and apparently insurmountable obstacles surround that great secret; but what scientists are learning, rather slowly to be sure, is how to go about the necessary investigations—hitherto they were attempting what might be termed methods of direct assault. A discussion of some of the questions involved will be found in an illuminating paper on *Life and the Structure of the Molecule* in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2247 for January 25th. *Contraband Trade Between Switzerland and Germany* notes conditions prevailing during the war, and the accompanying illustrations show some of the methods employed by smugglers. The habitat groups in the American Museum of Natural History are of wide interest both on account of their artistic excellence and because of the unusual character of the material often available. One of the new groups nearing completion is devoted to that rare animal, the white rhinoceros. This will include one of the finest specimens in the world, a bull having a horn 42 inches long, and a female with a 36-inch horn. The museum collection includes specimens obtained by Colonel Roosevelt, and also the most complete collection of skulls of every age and of many shapes in the world. An article on *The Finest Specimens of White Rhinoceros in Africa* with illustrations, show the record bull and some of the skulls, and some interesting general information is given. *How Matches Are Made* gives some facts about the manufacture of the millions of these indispensable little articles that are consumed every day in all parts of the world, and a number of excellent photographs show the machinery and processes employed. *Taking Photographs from Airplanes and Balloons* describes and illustrates some of the special and unusual cameras developed for this unique kind of photography. Other articles in this issue include *Zirconia as a Refractory*, *The Ignition Temperature of Gaseous Mixtures*, *Antiscorbutic Principles of Limes and Lemons*, *Fringing Reefs of the Philippine Islands* and *The Interconnection of Economic Botany and Chemical Industry*.

New Glands of the Platypus

IN the course of work on the anatomy of the platypus (*Ornithorhynchus paradoxus*), the Australian mammal which lays eggs and forms a link between the birds and the mammals, Dr. Colin McKenzie and W. J. Owen have established the existence of three glands new to science. These are a cervical set gland, a large scapula gland and the parathyroid. The functions of these glands has not yet been determined.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Surgical Machinery Up to Date

IT is almost a commonplace to remark that the war has reduced surgery to a precise mechanical art. Nevertheless, as the various devices for converting the hospital into a machine shop pass in review, the layman will hardly be able to retain completely the garb of sophistication, or to restrain altogether some expression of surprise.

One of the latest exhibits of this sort of thing is the arm splint which we illustrate herewith. It is obvious enough that this splint gives the necessary degree of rigidity; but here it merely duplicates existing devices, instead of surpassing them. Its advantages consist in the fact that it can be used on either arm indifferently, and can be adjusted to any desired position of the arm and of the wearer.

The new splint has been ordered in quantities for use in our base hospitals, here and abroad, and it is violating no dictate of military secrecy to state that the American Red Cross is responsible for its design and adoption. The advantages of having one splint applicable to all cases of arm wounds are so obvious that we need not dilate upon them here. It is just the same game of standardized trucks and standardized airplane engines all over again, on a smaller scale.

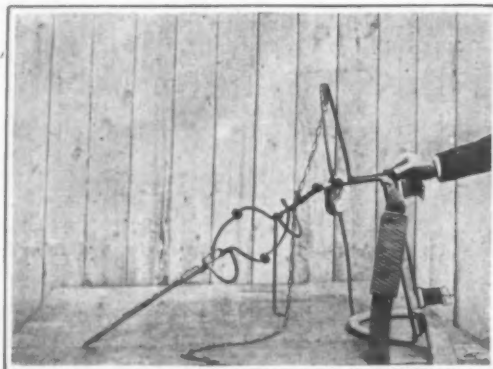
Weighing the Temperature for Blind Folk

By Jacques Boyer

THE victims of blindness, whose number the war has unfortunately so increased, excite more and more the interest of a sympathetic world, which strives to ameliorate their lot by providing them with a variety of useful appliances. In the course of the past few years, various workers have adapted to the use of the blind certain machines, tools, and even games; the Braille slate and the Braille typewriter furnish instances selected at random. Today comes a resident of Nîmes, M. Fleury Brunet, with a curious thermometer that he has invented to make it possible for persons deprived of their sight to read the temperature quite as well as anybody else.

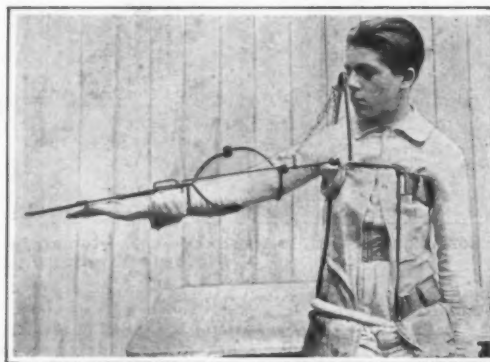
The device is a calorimetric balance, with which one actually weighs the temperature, if we may be permitted this expression. It is a combination of a balance beam with a mercurial thermometer, using the motion of the mercury column to displace the center of gravity of the tube and permit the blind man to read, from its position, the degrees of temperature marked on an index scale.

The inventor has worked out his conception in a fashion at once elegant and sound. The scale is carried on two steel



The standardized adjustable arm splint

bars, along which it can be slid for a short distance backward and forward. It is graduated in Braille characters, the lower temperatures being above and the upper ones below. The principal member is a rather heavy bar of aluminum, supported, on a knife-edge bearing, at a point near one end. On its long arm it carries an ordinary mercurial ther-



How the new splint goes on the patient

for whatever temperature is to lie in the middle of the instrument's range—which ordinarily runs from zero to 40° Centigrade. The column of mercury then plays the role of running weight; and by its varying position it controls the position of the balance—when the temperature rises and the mercury moves outward along the beam, the pointed

one of the holes of the scale, and penetrates a little way on the other side. It is then locked in position, and the blind man can find it and read the corresponding Braille character without any danger of displacing it and altering the accuracy of his reading. Having found the temperature, the blind man moves the scale back to normal position, and the pointer is again free to oscillate under the influence of temperature changes.

Inability to read the temperature, while not the worst of the blind man's disabilities, is far from being the

least annoying; and this clever means of removing it will be appreciated.

A Stretcher That Gives Up Its Load Painlessly

IN the strides made during the past decade by medical science and surgery, little attention has been paid to one of the minor, but none the less urgent, points in the handling of the injured—the means of getting them off the stretcher and into the bed. Every doctor will concede that the current style of handling patients in this transfer leads to irritation and shock which, in severe cases, may become a serious complication. But there has been no suggested means for avoiding these unpleasant consequences.

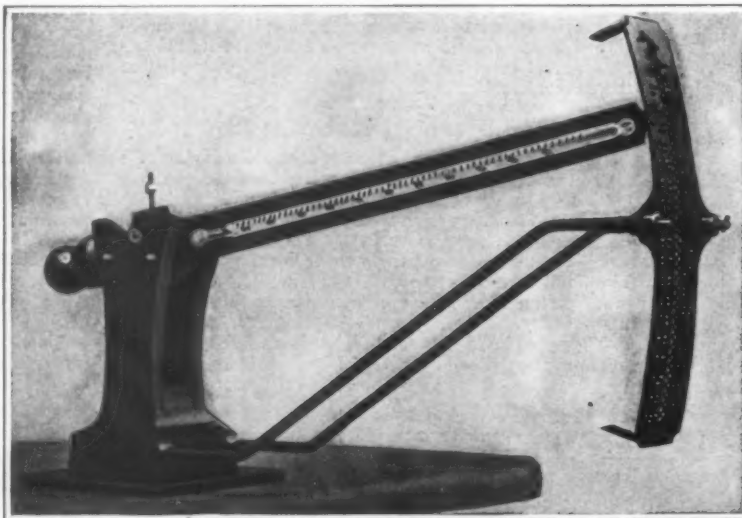
The stretcher shown on this page divides longitudinally in the middle. Each half of the canvas may then be slipped from under the patient, after he has been deposited, in the stretcher, on his bed or operating table; so the transfer takes place with no handling and no shock.

The center coupling of the new stretcher consists of two fine steel rods, three feet long—one running from each end of the stretcher through canvas loops that extend alternately from each side. These rods meet in the center loop, and are locked in place by a canvas strap that buttons over their outer ends in such fashion as absolutely to prevent their slipping out, while each rod checks the other in any tendency to slip inward. The folding handles reduce the minimum length of the stretcher to six feet, making delivery possible to the standard hospital bed, six feet two inches in length.

The iron spreading rods have a slot at the center of one which slips over a rivet at the center of the opposite rod, and, when rigidity is in order, is locked

by a pin penetrating both rods. This pin in turn is held in place by a small flat steel spring. On releasing this lock the spreading rods swing in under the canvas, and counter-sink into the wooden frame; whereupon the entire stretcher folds into a bundle, light and compact, six feet long and eight inches thick.

This stretcher was invented by M. V. Hubbard, an ambulance driver in the fire department of San Jose, California.

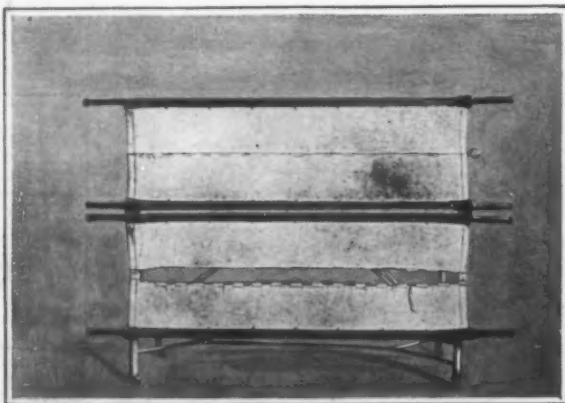


The thermometer that weighs the temperature so that the blind can read it

mometer, rigidly mounted; and this arm terminates in a point. The short arm ends in a heavy ball, and is provided in addition with two blocks, which may be slid back and forth and locked in position. This makes it possible so to calibrate the instrument that the aluminum beam takes a horizontal position

end of the latter falls, and in the opposite case it rises.

The point of the beam fails to touch the scale in the normal position of the latter. When a blind man wants to read the instrument, however, he pushes the scale in toward the base; and as he does so, the pointed beam passes through



The stretcher that divides down the middle to give up its load without handling



Shockless transfer from ambulance to bed, by means of the dividing stretcher



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Submarine Range-Finding by Means of Reflected Sound Waves

(Continued from page 67)

which are above the audibility range of the human ear. For one thing, such high frequency sound waves may be readily received with little if any interference from the many other sounds existing in water. Again, such waves make it extremely difficult for a hostile ship, particularly a submarine, to detect the sending source through the use of a similar installation. When sound waves of a pitch above the audibility range of the human ear are employed, the receiving circuit includes some form of interrupter or "chopper," which breaks up the high pitched sound so that it may be heard by the human ear.

While primarily designed for anti-U-boat operations, the present device has a permanent use. It literally enables the mariner to "see" under water. Uncharted ledges and pinnacles can be detected, and wrecks can be located. What is more, Mr. Ries claims that with a little practice the operator ought soon be able to tell the difference between various materials, such as sand, rock, wood, iron and so on, since each material reflects the sound waves differently because of the varying acoustic absorption of each.

The Voice of the Sea

(Continued from page 71)

fish and the richly colored sea gardens of the Pacific at Santa Catalina. At San Diego the yachtsman finds his paradise, while at Coronado one may watch the feathery spray tumbling gloriously over the breakwater. The long high ridge of Point Loma overlooks the bay, while from commanding view-points the desert mountains of Mexico blend softly with the sky.

On summer days I have followed the rolling hills along the ocean to the south of San Francisco, peering over precipitous bluffs at tiny curving beaches, bounded by rocky headlands and outlying reefs of tilted strata, on which the seals and the white gulls play. The long blue waves of the Pacific break with stately rhythm on the sand or tower in spray upon the rocks, and the voice of the sea is sweetest music to the ear. Come with me through the grain fields dotted with golden poppies, over the flower-strewn hillsides, joyous with birds and butterflies, down through thick cedars to the singing sands of the seashore, down to the long brown kelp and the waving mosses!

The sea is a symbol of eternity. As we become more deeply acquainted with it we more truly love its mystery and more clearly understand its message to our hearts. There are silent moments upon the mountains when one feels the immensity of nature, and there are storms upon the sea in which one realizes the presence of an immeasurable power. He has but lived in part to whose heart the mountains and the sea have never spoken. Both supply an infinite need of the soul. In the solitude of the mountains and in the voice of the storm-driven sea there is companionship with the Eternal.

Curved or "S" Courses

(Continued from page 73)

yards longitudinally and 110 yards literally. These errors are what may be ordinarily expected in mortar firing at a vessel steering an "S" course. The sinuous course causes a loss in hitting power of mortar batteries of about 50 per cent, so that only high velocity rifles should be used in future installations, confining the use of mortars to special cases. The result of these tests demonstrated the vulnerability of coast defenses armed with mortars when bombarded at long range by warships steering a sinuous bombardment curve. As a result of the invention of the Automatic Course Indicator the firing system and armament of coast defenses will have to be radically revised.

"In regard to gunfire, a lesser but very material error is introduced. In the case

(Continued on page 84)

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All patents secured through us are described without cost to the patentee in the SCIENTIFIC AMERICAN.

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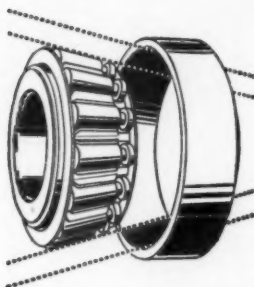
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The tapered design enables the bearing to resist not only *up-and-down* loads, bumps and pressures, but also the heavy *side or end-pressures* that are always present in some degree in a moving vehicle—jolted to right or left, swinging around curves, struggling out of ruts and bumping over holes, stones, and so on.

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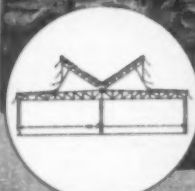
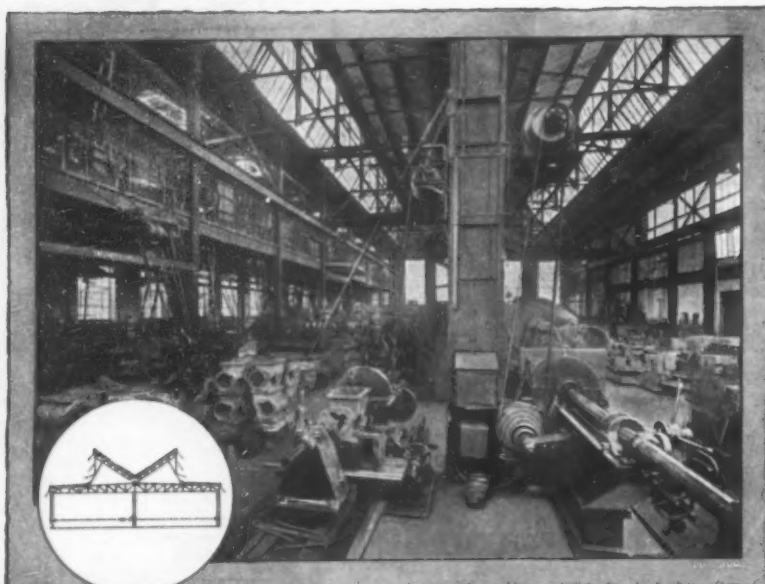
Secondly—if a little wear does occur after thousands of miles, it can be quickly and easily corrected, just by moving the tapered "cone" and rollers a trifle farther into the tapered cup. This simple "take-up for wear" extends the life of the bearings indefinitely.

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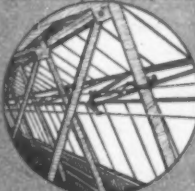




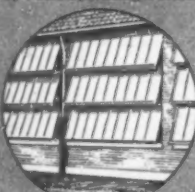
Section of a typical Pond Truss building.



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INVESTMENT VALUE

Curved or "S" Courses

(Continued from page 82)

of 12-inch guns the prediction interval is only 30 seconds and time of flight from 15 to 30 seconds. The error appears to be proportional or nearly so to the time interval at which the future position of the ship on the 'S' course must be guessed. On a straight course the average error in the set-forward point is about 24 yards. With the target head-on when steering an 'S' course, at ranges between 7,000 and 12,000 yards, the total probability of hitting is reduced by 25 per cent and with the target broadside the sinuous course at 8,000 yards range reduces the longitudinal probability of hitting about 10 per cent. At the longer ranges, 18,000 and 21,000 yards, the sinuous course will give an attacking fleet more immunity than now from rifle fire. When spotfiring is resorted to the error will be far greater even than that indicated above.

"The importance of these tests cannot be too strongly emphasized. As the mortar and gunfire from a land battery having a long horizontal and high vertical base line, at 8,000 yards range, was seriously affected, how much more will be the effect upon gunfiring between battle fleets at 18,000 yards range which resort to spotfiring! A fleet on an 'S' course will be much more immune from the enemy's guns, while her own control officers, knowing the 'S' course, can alter their ship's fire as the curve changes."

The Final Solution of the Airship Problem

(Continued from page 73)

owing to the fact that the outer cover is made as a rule of a non-gas-tight material, thus allowing for some renewal of the air; certain constructors, Forlanini for instance, provide means for ventilating the ring space at will by means of a system of valves.

Of course, all these are merely peace time risks, which in time of war are further complicated by the intervention of hostile airplanes firing incendiary bullets—as the list of German Zeppelin losses proves with considerable forcefulness. It is small wonder then that as long as the industrial production of helium had been considered impossible the airship should have been condemned for all but some special purposes, more distinctly naval: fleet scouting, coast patrol and submarine chasing. It is, perhaps, not unfitting to add here in view of what has been said about the drawbacks of hydrogen that the officers and crews manning airships in time of war are exceedingly gallant men—be they even Germans.

The Virtues of Helium

It may seem strange that an article which purports to extol the virtues of helium as a lifting gas—helium, which the Navy Department camouflaged for reasons of national security as "argon" until the war was won—should pay so much attention to the drawbacks of hydrogen. But as a matter of fact it is only by this procedure that the reader can be made to appreciate fully the principal factor which ever since Giffard's days has obstructed the logical development of the airship into the aerial liner and battleship.

Helium, besides being, as has already been said, absolutely non-inflammable, also refuses to be absorbed and therefore, cannot form, through diffusion in air, an explosive mixture; hence it eliminates in the airship the principal elements of danger and promises to bring about nothing short of a revolution in aerial navigation. As against this very great advantage helium possesses only a small drawback with respect to hydrogen: its lifting force is about 8 per cent smaller than that of hydrogen, because helium is about twice as heavy as the latter. Helium will thus lift about 65 pounds per 1,000 cubic feet, as against 70 pounds for commercial hydrogen. This drawback is, however, really insignificant in the light of the enormous advantages the new lifting gas possesses.



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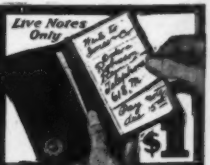
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The advance which the quantity production of helium promises to effect in the technique as well as in the application of airships can hardly be overrated. One may already foresee that, with the fire risk eliminated, it will be possible to fit the engines into the hull proper of rigid airships and thus design a more efficient propelling system; this will produce a more homogeneous ensemble, almost absolute streamline shape, greater structural strength, and better all round performance. That such progress will benefit civilian as much as—if not more than—military and naval pursuits seems a foregone conclusion.

Battleplane Armament

(Continued from page 75)

The armored plane has appeared on various occasions in the great war, usually on the German side. Such attempts to protect airmen and engines have generally proved a failure, for the reason that the loss in speed and climbing ability has more than offset the gain in protection from hostile small-arms fire. Indeed, such machines have only too often fallen victims to artillery fire from the ground. A typical armored plane designed by the Germans for operations against troops on the ground was brought down by the Americans during the closing days of active fighting. This machine, which was probably of the Junker type, was a two-seater and carried three guns—one firing directly ahead, one mounted on a tourelle, and the third arranged to fire through a well in the floor at targets on the ground.

All in all, the tendency has been to increase the machine-guns wherever feasible, but considerations of speed and climbing ability have set severe limits in that direction. After four years of war the little chaser, with its single passenger and one or two machine-guns, has proved the real battleships of the skies. It may be that things will change in time; but until the signing of the armistice the chaser remained the final word in aerial fighting.

The Principles of Camouflage

(Continued from page 76)

plane, aerial photography became a more important factor than visual observation in much of the reconnaissance. This necessitated that camouflage in order to be successful had to meet the requirements of the photographic eye as well as of the human eye. In other words the spectral characteristics of the colors used had to be similar to those of Nature's colors. For example, chlorophyll, the green coloring matter of vegetation, is a peculiar green as compared with green pigments. When examined with a spectroscope it is seen to reflect a band of deep red light not reflected by ordinary pigments. So a photographic plate or spectroscope will reveal a difference which the unaided eye does not.

Some time before the Great War began, it occurred to the writer that colored filters could be utilized in aiding vision by increasing the contrast of the object to be viewed against its surroundings. Studies were made of various filters, in viewing the uniforms of various armies. Further developments were made by applying the same principles to colored lights and painted pictures. As a result of the demand for avoiding detection by photographic plates and by various colored filters, some paints provided for the camouflage were developed according to the spectral requirements. Many other applications of science were developed so that camouflage can now be called an art based upon sound scientific principles.

Natural lighting is so variable that it is often impossible to provide camouflage which will remain satisfactory from day to day; therefore, a broad knowledge of Nature's lighting is necessary in order to provide the best compromise. There are two sources of light in the daytime, namely the sun and the sky. The relative amounts of light contributed by these two sources is continually changing. The sky on cloudless days contributes from $\frac{1}{8}$ to $\frac{1}{4}$ of the



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total light received by a horizontal surface at noon. Light from the sky and light reflected from the surroundings illuminate the shadows. These shadows are different in color from highlights because color becomes less conspicuous as the distance of observation increases. In general the distribution of brightness or light and shade is the most important aspect to be considered.

The camoufleur worries over shadows more than any other aspect generally. On overcast days camouflage is much more successful than on sunny days. Obviously countershading is resorted to in order to eliminate shadows and where this is unsuccessful confusion is resorted to by making more shadows. The shape and orientation of a building is very important to those charged with the problem of rendering it inconspicuous to the enemy, but little attention has been paid to these aspects. For example, a hangar painted a very satisfactory dull green will be distinguishable by its shape as indicated by its shadow and shaded sides. In this zone a hangar, for example, would be more readily concealed if its length lay north and south. Its sides could be brought with a gradual curve to the ground and its rear, which is during most of the day in shadow, could be effectively treated to conceal the shadow. A little thought will convince the reader of the importance of shape and orientation.

Broken color or pattern is another fundamental of camouflage which, of course, must be adapted to its environment. For our trucks, cannon, and many other implements of war, dark green, yellow, dark blue, light gray and other colors have been used in a jumble of large patterns. A final refinement is that of the blending of these colors at a distance, where the eye no longer resolves the individual patches, to a color which stimulates the general hue. For example, red and green patches at a distance blend to yellow; yellow and blue patches blend to a neutral gray if suitably balanced, but if not, to a yellow gray or a blue gray; red, green and blue if properly balanced will blend to a gray; black, white and green patches will blend to a green shade; and so on. These facts are simple to those who are familiar with the science of light and color; but the artist, whose knowledge is based upon the mixture of pigments often errs in considering this aspect of color-blending by distance.

In constructing such a pattern of various colors it is also desirable to have the final mean brightness approximate that of the general surroundings. This problem can be solved by means of the photometer and a formula provided which states, for example, that a certain percentage of the total area be painted in gray, another percentage in green, and so on. The photometer has played an important role in establishing the scientific basis of camouflage.

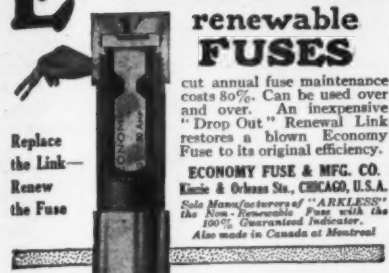
Where the artist is concerned with a background which does not include the sky, that is, where he deals only with illuminated objects on the earth, his trained eye is valuable provided the colors used meet the demands made by photographic plates and colored filters. In other words, the sky as a background, gives trouble to all who are unfamiliar with scientific measurements. The brightness of sky and clouds are far outside the scale of brightnesses ordinarily encountered.

One of the most conspicuous aspects of Nature's surface is its texture. From great heights it appears flat, that is, rolling land is ironed out and the general contour of the ground is flattened. However, the element of texture always remains. This is the chief reason for the extensive use of netting on which dyed raffia, foliage, pieces of colored cloth, etc., are tied. Such network has concealed many guns, headquarters, ammunition dumps, communication trenches, roadways, etc. When this has been well done the concealment is perfect.

One of the greatest annoyances to the camoufleur is the lack of dulness or "flatness" of the paints, fabrics, and some of



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the other media used. When viewed at some angles the glint or highlight due to specular reflection renders the work very conspicuous. For this reason natural foliage or dyed raffia has been used.

Systems of network have been extensively employed on roadways near the front not for the purpose of concealing from the enemy the fact that the roadways exist, but to make it necessary to shell the entire roadway continually if it is hoped to prevent its use.

Although the camoufleur is provided with a vast amount of material for his work many of his requirements are met by the material at hand. Obviously the most convenient method of providing concealment for a given environment is to use the materials of the environment. Hence rubbish from ruined buildings or villages supply camouflage for guns, huts, etc., in that environment. In woods the material to simulate woods is at hand. The color of the soil is important for if it is conspicuous the camoufleur must provide screens or natural turf.

In this great game of hocus pocus many deceptions are resorted to. Replicas of large guns and trenches are made; dummy soldiers are used to foil the sniper and make him reveal his location, and paper mache horses, trees, and other objects conceal snipers and observers and afford listening posts. Gunners have been dressed in summer in green flowing robes. In winter white robes have been utilized.

In the foregoing only the highlights of a vast art have been viewed but the art is still vaster for it extends into other fields. Sound must sometimes be camouflaged and this can only be done by using the same medium—sound. In these days of scientific warfare it is to be expected that the positions of enemy guns would be detected by other means than employed in the past. A notable method is the use of velocity of sound. Records are made at various stations of the firing of a gun and the explosion of the shell. By simple trigonometric laws the position of the gun is ascertained. It is said that the Germans fired a number of guns simultaneously with the "75-mile" gun in order to camouflage its location. The airplane and submarine would gladly employ sound camouflage in order to foil the sound detector if practicable solutions were proposed.

The foregoing is a brief statement of some of the fundamental principles of land camouflage. Let us now briefly consider the eyes of the enemy. Of course, much concealment and deception is devised to foil the observer who is on the ground and fairly close. The procedure is obvious to the average imagination; however, the reader may not be acquainted with the aerial eyes from which concealment is very important. As one ascends in an airplane to view a landscape he is impressed with the inadequacy of the eyes to observe the vast number of details and of the mind to retain them. Field glasses can not be used as satisfactorily in an airplane as on the ground owing to vibration and other movements. The difference is not as great in the huge flying boats as it is in the ordinary airplane. The camera can record many details with higher accuracy than the eye. At an altitude of one mile the lens can be used at full aperture and thus very short exposures are possible. This avoids the difficulty due to vibration. When the plates are developed for detail and enlargements are made, many minute details are distinguishable. Furthermore, owing to the fact that the spectral sensibilities of photographic emulsions differ from that of the eye contrasts are often brought out which the eye would not see. This applies also to camouflage which is devised merely to suit the eye. Individual footprints have been distinguished on prints made from negatives exposed at an altitude of 6,000 feet. By means of photography daily records can be compared. The disappearance of a tree from a clump of trees may arouse suspicion. Sometimes a wilted tree has been noted on a photograph which naturally attracts attention to this



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Decoy Ships for Submarines

(Continued from page 77)

Thus, the action of the decoy "Q-5" is described as follows:

"H. M. S. 'Q-5' was struck by a torpedo abreast of No. 3 hold. Action stations were sounded, and the 'panic party' abandoned ship. The engineer officer reported that the engine room was flooding, and was ordered to remain at his post as long as possible, which he and his staff, several of whom were severely wounded, most gallantly did. The submarine was observed on the starboard quarter 200 yards distant, watching the proceedings through his periscope. He ran past the ship on the starboard side so closely that the whole hull was visible beneath the surface, finally emerging about 300 yards on the port bow.

"The enemy came down the port side of the ship, and fire was withheld until all guns could bear at point-blank range. The first shot beheaded the captain of the submarine as he was climbing out of the conning tower, and the submarine finally sank with conning tower open and crew pouring out.

"The action may be regarded as the supreme test of naval discipline. The chief engineer and engine room watch remained at their posts to keep the dynamo working until driven out by the water, then remaining concealed on top of the cylinders. The guns' crews had to remain concealed in their gun houses for nearly half an hour, while the ship slowly sank lower in the water. Commander Gordon Campbell, for this action, was awarded the Victoria Cross."

One scarcely regards a little 200-ton schooner as standing much chance in a fight with a U-boat; so the following official story has special interest.

"Lieut. William Edward Sanders, R. N. R., was awarded the Cross for an action of H. M. S. 'Prize' on April 30th last. The 'Prize,' a topsail schooner of 200 tons, sighted an enemy submarine, which opened fire at three miles' range and approached slowly astern. The 'panic party,' in charge of Skipper William Henry Brewer, R. N. R. (Trawler Section), immediately abandoned ship. The ship's head was put into the wind, and the guns' crews concealed themselves by lying face downwards on the deck.

"The enemy continued deliberately shelling the schooner, inflicting severe damage and wounding a number of men. For 20 minutes she continued to approach, firing as she came, but at length, apparently satisfied that no one remained on board, she drew out on the schooner's quarter seventy yards away. The White Ensign was immediately hoisted, the screens dropped, and all guns opened fire. A shell struck the foremost gun of the submarine, blowing it to atoms and annihilating the crew. Another shot demolished the conning tower, and at the same time a Lewis gun raked the survivors off the submarine's deck. She sank four minutes after the commencement of the action in clouds of smoke, the glare of an internal fire being visible through the rents in her hull.

"The Captain of the submarine, a warrant officer, and one man were picked up and brought on board the 'Prize,' which was then herself sinking fast. Captors and prisoners, however, succeeded in plugging the shot-holes and keeping the water under with the pumps. The 'Prize' then set sail for the land, 120 miles distant. She was finally picked up two days later

by a motor launch and towed the remaining five miles into harbor."

Another thrilling story is that of a little 360-ton collier, commanded by her designer:

"Lieut. Harold Auten, V. C., D. S. C., R. N. R., was in command of H. M. S. 'Stock Force' on July 30th, 1918, when she was torpedoed by an enemy submarine at 5 P. M. The torpedo struck the ship abreast No. 1 hatch, entirely wrecking the fore part of the ship, including the bridge, and wounding three ratings. A tremendous shower of planks, unexploded shells, hatches, and other debris followed the explosion, wounding the first lieutenant (Lieut. E. J. Grey, R. N. R.) and the navigating officer (Lieut. L. E. Workman, R. N. R.), and adding to the injuries of the foremost gun's crew and a number of other ratings. The ship settled down forward, flooding the foremost magazine and between decks to the depth of about three feet. The 'panic party,' in charge of Lieutenant Workman, R. N. R. immediately abandoned ship, and the wounded were removed to the lower deck, where the surgeon (Surgeon Probationer G. E. Strahan, R. N. V. R.), working up to his waist in water, attended to their injuries. The captain, two guns' crews, and the engine room staff remained at their posts.

"The submarine then came to the surface ahead of the ship half a mile distant, and remained there a quarter of an hour, apparently watching the ship for any doubtful movement. The 'panic party' in the boat accordingly commenced to row back toward the ship in an endeavor to decoy the submarine within range of the hidden guns. The submarine followed, coming slowly down the port side of the 'Stock Force,' about 300 yards away, Lieutenant Auten, however, withheld his fire until she was abreast, when both of his guns could bear. Fire was opened at 5.40 P. M.; the first shot carried away one of the periscopes, the second round hit the conning tower, blowing it away and throwing the occupant high into the air. The next round struck the submarine on the waterline, tearing her open and blowing out a number of the crew.

"The enemy then subsided several feet into the water and her bows rose. She thus presented a large and immobile target, into which the 'Stock Force' poured shell after shell until the submarine sank by the stern, leaving a quantity of debris on the water. During the whole of the action one man (Officer's Steward, Second Class, R. J. Starling), remained pinned down under the foremost gun after the explosion of the torpedo, and remained there cheerfully and without complaint, although the ship was apparently sinking, until the end of the action."

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"H. M. S. 'Q-5' was struck by a torpedo abreast of No. 3 hold. Action stations were sounded, and the 'panic party' abandoned ship. The engineer officer reported that the engine room was flooding, and was ordered to remain at his post as long as possible, which he and his staff, several of whom were severely wounded, most gallantly did. The submarine was observed on the starboard quarter 200 yards distant, watching the proceedings through his periscope. He ran past the ship on the starboard side so closely that the whole hull was visible beneath the surface, finally emerging about 300 yards on the port bow.

"The enemy came down the port side of the ship, and fire was withheld until all guns could bear at point-blank range. The first shot beheaded the captain of the submarine as he was climbing out of the conning tower, and the submarine finally sank with conning tower open and crew pouring out.

"The action may be regarded as the supreme test of naval discipline. The chief engineer and engine room watch remained at their posts to keep the dynamo working until driven out by the water, then remaining concealed on top of the cylinders. The guns' crews had to remain concealed in their gun houses for nearly half an hour, while the ship slowly sank lower in the water. Commander Gordon Campbell, for this action, was awarded the Victoria Cross."

One scarcely regards a little 200-ton schooner as standing much chance in a fight with a U-boat; so the following official story has special interest.

"Lieut. William Edward Sanders, R. N. R., was awarded the Cross for an action of H. M. S. 'Prize' on April 30th last. The 'Prize,' a topsail schooner of 200 tons, sighted an enemy submarine, which opened fire at three miles' range and approached slowly astern. The 'panic party,' in charge of Skipper William Henry Brewer, R. N. R. (Trawler Section), immediately abandoned ship. The ship's head was put into the wind, and the guns' crews concealed themselves by lying face downwards on the deck.

"The enemy continued deliberately shelling the schooner, inflicting severe damage and wounding a number of men. For 20 minutes she continued to approach, firing as she came, but at length, apparently satisfied that no one remained on board, she drew out on the schooner's quarter seventy yards away. The White Ensign was immediately hoisted, the screens dropped, and all guns opened fire. A shell struck the foremost gun of the submarine, blowing it to atoms and annihilating the crew. Another shot demolished the conning tower, and at the same time a Lewis gun raked the survivors off the submarine's deck. She sank four minutes after the commencement of the action in clouds of smoke, the glare of an internal fire being visible through the rents in her hull.

"The Captain of the submarine, a warrant officer, and one man were picked up and brought on board the 'Prize,' which was then herself sinking fast. Captors and prisoners, however, succeeded in plugging the shot-holes and keeping the water under with the pumps. The 'Prize' then set sail for the land, 120 miles distant. She was finally picked up two days later

by a motor launch and towed the remaining five miles into harbor."

Another thrilling story is that of a little 360-ton collier, commanded by her designer:

"Lieut. Harold Auten, V. C., D. S. C., R. N. R., was in command of H. M. S. 'Stock Force' on July 30th, 1918, when she was torpedoed by an enemy submarine at 5 P. M. The torpedo struck the ship abreast No. 1 hatch, entirely wrecking the fore part of the ship, including the bridge, and wounding three ratings. A tremendous shower of planks, unexploded shells, hatches, and other debris followed the explosion, wounding the first lieutenant (Lieut. E. J. Grey, R. N. R.) and the navigating officer (Lieut. L. E. Workman, R. N. R.), and adding to the injuries of the foremost gun's crew and a number of other ratings. The ship settled down forward, flooding the foremost magazine and between decks to the depth of about three feet. The 'panic party,' in charge of Lieutenant Workman, R. N. R. immediately abandoned ship, and the wounded were removed to the lower deck, where the surgeon (Surgeon Probationer G. E. Strahan, R. N. V. R.), working up to his waist in water, attended to their injuries. The captain, two guns' crews, and the engine room staff remained at their posts.

"The submarine then came to the surface ahead of the ship half a mile distant, and remained there a quarter of an hour, apparently watching the ship for any doubtful movement. The 'panic party' in the boat accordingly commenced to row back toward the ship in an endeavor to decoy the submarine within range of the hidden guns. The submarine followed, coming slowly down the port side of the 'Stock Force,' about 300 yards away, Lieutenant Auten, however, withheld his fire until she was abreast, when both of his guns could bear. Fire was opened at 5.40 P. M.; the first shot carried away one of the periscopes, the second round hit the conning tower, blowing it away and throwing the occupant high into the air. The next round struck the submarine on the waterline, tearing her open and blowing out a number of the crew.

"The enemy then subsided several feet into the water and her bows rose. She thus presented a large and immobile target, into which the 'Stock Force' poured shell after shell until the submarine sank by the stern, leaving a quantity of debris on the water. During the whole of the action one man (Officer's Steward, Second Class, R. J. Starling), remained pinned down under the foremost gun after the explosion of the torpedo, and remained there cheerfully and without complaint, although the ship was apparently sinking, until the end of the action."

The Sahara Hydrological Station

THE General Government of Algeria has just decided to create a "Saharan Hydrological Station" for the comprehensive scientific and practical study of the various problems connected with the vitally important water supply of the great desert. Among its activities will be included a census and survey of all the wells which supply the various oases, and an accurate determination of the yield of water; in the case of newly sunk wells especial note will be taken of the amount of floor when first opened in comparison with a later yield. This is rendered necessary by the fact that many wells show a marked decrease of yield after having been open for a few years, thus indicating that the source of supply was not inexhaustible. It was formerly supposed that such sources consisted of sheets of water located in subterranean basins; while this is probably true in some cases it is now believed that in many parts of the Sahara the water supply is distributed in "networks of thread-like streams" occupying positions which are variable both in the horizontal and in the vertical plane in the midst of the sedimentary strata.

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